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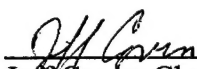
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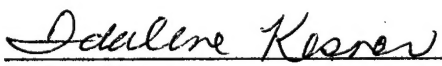
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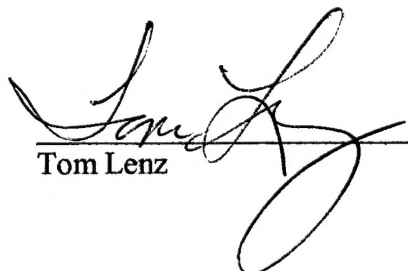
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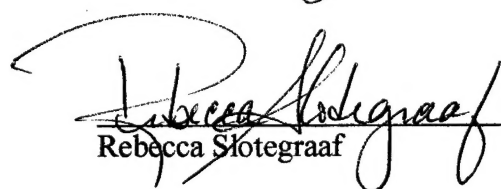

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ABSTRACT

Merger and acquisition (M&A) activity represents a major force in the global business environment, whether measured by the number or the value of deals. Even though existing research finds acquisitions, on average, do not improve firm performance, the dominant explanation for why firms pursue acquisitions is that they seek increased performance. There is a recognized need to model post-acquisition performance to help distinguish between acquisitions that will fail and those that will succeed. By addressing methodological shortcomings in existing post-acquisition performance research, the present research develops a model for predicting when acquisitions of high-technology targets result in improved performance. Implications for both theory and managerial practice are identified.

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CHAPTER 1

INTRODUCTION

Merger and acquisition (M&A) activity represents a common occurrence in the business environment of firms.¹ Between 1994 and 2000 the number of acquisitions worldwide set a new record each year with over 35,000 transactions occurring in 2000 (*Wall Street Journal*, 2001). Additionally, the value of acquisition activity hit a record \$1.6 trillion in the first ten months of 2000 (*Wall Street Journal*, 2000). Several explanations have been offered for why firms pursue acquisitions including: circumvention of entry barriers (Singh & Montgomery, 1987), increased speed of entry (Capron, 1999), and lower entry costs than internal development (Roberts & Berry, 1985; Mansfield, 1988). However, the dominant rationale used to explain acquisition activity is that acquiring firms seek higher performance (Bergh, 1997; Carper, 1990; Hoskisson & Hitt, 1990; Seth, 1990b; Sirower, 1997).

Despite this dominant rationale research suggests acquisitions, on average, do not improve firm performance (e.g., Datta, Pinches & Narayanan, 1992; King, *et al.*, 2002; Ravenscraft & Scherer, 1987). The continued use of acquisitions as a strategic tool by firms in the face of evidence that acquisitions do not increase performance represents an unsolved “puzzle” (Agrawal & Jaffe, 2000). The problem is that existing research does not predict when acquisitions are successful, or will result in improved performance.

There are several possible explanations for the mixed research findings in existing post-acquisition performance research. First, existing post-acquisition performance studies primarily use wide cross-sections that assume all acquisitions are the same.

¹ In the present research, only the term *acquisition* is used (even in mergers one firm is still identified as the acquiring firm) and it is defined as a transaction between two firms that results in a single firm.

However, research suggests that there are different types of acquisitions (e.g., Bower, 2001; Haspeslagh & Jemison, 1991). If acquisitions are not all the same, then it should not be surprising that prior cross-sectional research based on the assumption of homogeneity often exhibits conflicting or insignificant results.

Second, there is little overlap in research variables used in acquisition studies. This suggests that existing models may be under-specified (King, *et al.*, 2002). For example, few studies in economics and finance consider the relatedness of acquisitions a central factor in strategy research (Larsson & Finkelstein, 1999), while most strategy research ignores the role of premium paid (Sirower, 1997). The impact of under-specification is that regression coefficients of included variables can be biased by variables that are significant but not included in the model (Griffiths, Hill & Judge, 1993: 312).

Third, the majority of post-acquisition performance research uses stock market event studies (Bild, 1998; Sirower, 1997) even though Keats (1988) found that stock and accounting performance measures represent different dimensions of financial performance. Additionally, short-term event studies based on the Capital Asset Pricing Model (CAPM) are criticized as not adequately capturing acquisition performance (e.g., Chatterjee, Lubatkin & Schulze, 1999; Loderer & Martin, 1992; Lubatkin & Shrieves, 1986).

Finally, with a few notable exceptions (e.g., Capron, 1999; Hitt, *et al.*, 1996; Hoskisson, *et al.*, 1993; Krishnan, Miller & Judge, 1997) post-acquisition performance studies rarely consider relationships beyond main effects. There is evidence; however, that post-acquisition performance is moderated, but by variables unspecified in existing

research (King, *et al.*, 2002). Therefore, modeling interactions represents a recognized need in post-acquisition performance research (Hitt, *et al.*, 1998; Hoskisson & Hitt, 1990).

The goal of the present research is to develop a post-acquisition performance model based on pre-acquisition factors. The study is designed to overcome the methodological shortcomings identified above which are common throughout existing post-acquisition research. Specifically, the present research focuses on a certain type of acquisition—high-technology acquisitions. These acquisitions have been identified as different from acquisitions in general (Chaudhuri & Tabrizi, 1999; Ranft & Lord, 2000, 2002), and during the 1990s high-technology industries were consistently among the most M&A active (Ranft & Lord, 2000). The high number of high-technology acquisitions produces a large enough sample for meaningful analysis facilitating their separate analysis. To avoid under-specification bias, the most common post-acquisition research variables identified through an extensive literature review are included in the model. Both accounting and stock market measures of an acquiring firm's post-acquisition performance are evaluated. Using multiple measures of acquisition performance is a recognized research need (Hoskisson & Hitt, 1990; Larsson & Finkelstein, 1999; Lubatkin, 1983) that should facilitate cumulating research across disciplines (Ramanujam & Varadarajan, 1989) and improve the understanding of differences between accounting and stock market measures (Hoskisson, *et al.*, 1993). Additionally, the stock market measure used is a long-term measure of post-acquisition performance. The developed model also includes interactions between acquiring and target firm variables; thereby satisfying recognized research needs (Hitt, *et al.*, 1998;

Hoskisson & Hitt, 1990). In summary, each of these changes represents a methodological contribution that, taken together, should offer theoretical insight and potentially increased success in predicting post-acquisition performance.

Conclusion

The current chapter introduced the research problem and goal. In the next chapter, existing literature is reviewed and the research model is presented. In Chapter three, the research methodology is presented, including descriptions of the sample, measures, and analysis. Results are presented in Chapter four. A discussion of implications and limitations of the research, along with opportunities for future research, are presented in Chapter five.

CHAPTER 2

THEORY AND HYPOTHESES DEVELOPMENT

This chapter begins with a review of research on post-acquisition performance with a focus on strategic management. The literature review is used as the basis of building a model of post-acquisition performance, including the development of specific research hypotheses. The chapter then concludes with a summary of the hypothesized impact of research variables on post-acquisition performance for firms acquiring high-technology targets.

Literature Review

The goal of the present literature review is to identify relevant antecedent variables of post-acquisition performance used in building a predictive model of post-acquisition performance. Importantly, the literature which is reviewed in this chapter focuses on identifying strategic management empirical studies of post-acquisition performance rather than reviewing all M&A research. Moreover, this review begins with Jensen and Ruback's (1983) review and ends with studies published through September 2002. A total of 51 empirical post-acquisition performance studies were identified and are summarized in Appendix A.²

A review of Appendix A shows that research conclusions concerning the impact of acquisitions on acquiring firm performance are equivocal. Out of the 51 studies summarized, 31 studies made non-qualified conclusions about the impact of acquisitions

² Multiple search techniques were used to identify empirical studies of post-acquisition performance. A combination of manual searches of article abstracts in the *Academy of Management Journal*, *Administrative Science Quarterly*, *Journal of Management*, and *Strategic Management Journal* issues for the last six years and computer-aided keyword searches were used to identify contemporary studies appearing in management journals. Additionally, the "ancestry" approach of article identification (e.g., Cooper, 1998) was used to identify additional articles from the references of identified articles in an iterative process.

on acquiring firm performance (see Table 1). The findings are essentially evenly distributed between acquisitions increasing firm performance and acquisitions having no impact or a negative impact on firm performance. This observation applies regardless of the performance measure employed. The category of "other" measures represents a smaller stream of research using alternative measures to capture the impact of acquisitions on firm innovation (e.g., Hitt, et al., 1991; Ahuja and Katila, 2001). A chi-square difference test based on the count data totals results in concluding that a significant difference between study findings does not exist ($p = .48$). Although this simple test does not account for sample or observed effect size, it is a striking realization that if one randomly looks at the results of two studies of post-acquisition performance one is as likely to observe conflicting as consistent findings. In brief, despite decades of research, the relationship between variables on post-acquisition performance remains largely unexplained.

Table 1: Research Conclusions on the Impact of Acquisitions on Firm Performance^a

Performance Measure	Increased Performance	No Impact or Decreased Performance
• Stock market only	6	8
• Accounting only	1	3
• Both Stock market and Accounting	3	4
• Other	4	3
Totals^b	14	18

^a Not significantly different based on Chi square comparison ($p = .48$)

^b Does not sum to 31 because one study used both accounting and other measures

A review of the studies summarized in Appendix A also reveals diversity in the independent variables used in existing research. This diversity indicates an opportunity to control for the independent effects of variables included in past research thereby limiting the problem of model under-specification. The ten most common independent variables that appear across the summarized studies are shown in Table 2. The impact of

firm diversification on subsequent performance has been given the most attention by researchers with some measure of diversification appearing in 31 of the 51 studies.

Table 2: Ten Most Common Post-acquisition Performance Research Variables

Variable	Number of Studies Using Variable ^a
• Diversification, any measure	31
• Firm size or Relative size	23
• Acquisition Experience	10
• Accounting method	7
• Industry controls	7
• R&D expenditures	6
• Hostile or Friendly acquisition	6
• Debt level	5
• Form of acquisition	5
• Target firm performance	4

^a Out of 51 studies

A comparison of findings on individual M&A research variables also shows equivocal results. For example, empirical evidence on the impact of diversification remains mixed (e.g., Fowler & Schmidt, 1989; Lubatkin, 1983, 1987; Palepu, 1985; Palich, Cardinal & Miller, 2000). The mixed findings relating to the impact of diversification involve a potential methodological problem with the measures of diversification used. For example, at least seven of the 31 reviewed studies measuring diversification relied on the 1948-1979 Federal Trade Commission (FTC) Large Merger Series database that has recognized limitations (Golbe & White, 1988) including the implicit assumption that the FTC's acquisition strategy and diversification typologies are valid—assumptions that have not been tested (Lubatkin, Srinivasan & Merchant, 1997). By comparison, a categorical entropy measure of diversification based on Standard Industrial Classification (SIC) codes has demonstrated construct validity (Hoskisson, *et al.*, 1993).³

³ A categorical entropy measure of diversification is used in the present research.

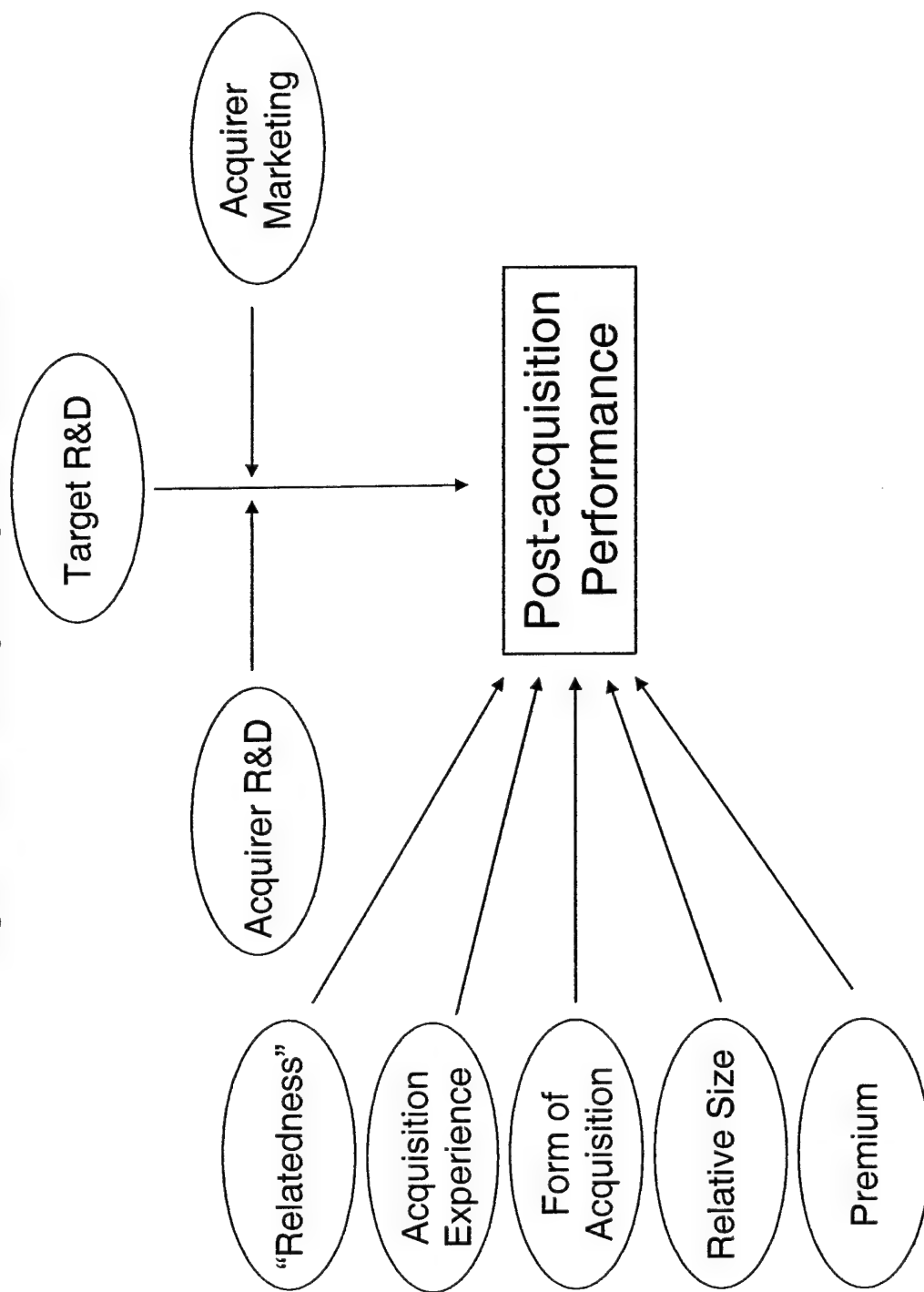
Model and Hypotheses

In the current study, the most common post-acquisition performance research variables are used as a foundation in developing a model to predict post-acquisition performance. Hypotheses 1 through 5 focus on pre-acquisition characteristics that impact the ability of acquiring firms to exploit the acquisition of high-technology targets. However, the model also represents a contribution to existing literature by including an interaction between the pre-acquisition investments made by an acquiring and a target firm, Hypotheses 6 and 7. The research model for predicting post-acquisition performance is shown in Figure 1 and is explained in the following sections.

Relatedness

Relatedness involves the degree that an acquiring firm's experience and resources are relevant in a target industry. The effect of firm diversification into related or into unrelated businesses on subsequent performance has received the most attention of strategy research on post-acquisition performance. Theory suggests that related acquisitions should lead to higher financial post-acquisition performance (Harrison, O'Neill & Hoskisson, 2000; Rumelt, 1974, 1982). However, empirical evidence is mixed. Some researchers have found relatedness leads to higher performance (Palepu, 1985; Palich, Cardinal & Miller, 2000) while others have found no relationship between relatedness and post-acquisition performance (e.g., Fowler & Schmidt, 1989; Lubatkin, 1987) or that unrelated acquisitions lead to higher performance (Lubatkin, 1983). Barney (1988) has also suggested that related acquisitions are a necessary but insufficient condition for predicting post-acquisition performance. However, the impact of relatedness on post-acquisition performance may depend on the type of acquisition.

Figure 1: Model Predicting Post-acquisition Performance



For the acquisition of high-technology targets, the R&D resources of the target firm represent a critical element. For these types of firms, the relatedness of a target firm should remain relevant for two reasons. First, technological progress is largely path dependent, and firms are more likely to search in areas related to their existing technological capabilities (Christensen & Rosenbloom, 1995; Stuart & Podolny, 1996). Second, integrating a target firm's resources calls for at least a minimum level of appreciation of a target firm's resources (Chatterjee & Wernerfelt, 1991) and how they could be combined with an acquiring firm's resources. For example, Porter (1987) found that companies were more likely to divest unrelated companies they acquired, and he concluded that achieving competitive advantage from skill transfers requires target firms to be similar enough to acquiring firms to ensure sharing expertise is meaningful.

Technology is primarily industry specific (Patel & Pavitt, 1997), so technology within the same industry should be more related than technology between industries. The relationship between industry experience and the capability to successfully recombine resources should hold because isomorphic influences lead firms to develop similar technological capabilities, and a shared understanding should facilitate resource integration and subsequent performance (Capron, Mitchell & Swaminathan, 2001). As a result, an acquiring firm is better able to exploit information imperfections (Barney, 1988) because it can better judge the future performance of a related target due to greater familiarity with technology, trends, and industry structure (Lubatkin, Srinivasan & Merchant, 1997; Hitt, Harrison & Ireland, 2001). Therefore, the following is hypothesized:

Hypothesis 1: The relatedness of a high-technology target is positively related to post-acquisition financial performance.

Acquisition Experience

A firm's experience with acquisitions may impact its ability to improve post-acquisition performance. Although acquisition experience has been considered an important variable since at least 1960 (*Booz-Allen and Hamilton*, 1960), consistent findings on its relationship with post-acquisition performance do not exist. For example, some researchers have found that prior acquisition experience predicts success in later acquisitions (Fowler & Schmidt, 1989; Bruton, Oviatt & White, 1994). On the other hand, Kusewitt (1985) found that as the number of acquisitions increase, post-acquisition performance declines. Yet another study found that acquisition experience has no impact on acquisition performance (Lahey & Conn, 1990). Still, Hitt *et al.* (2001: 55) caution that "the importance of the link between managerial experience and M&A success should not be underestimated."

Theory suggests that increased experience can build knowledge about how to perform acquisitions. Experience helps a firm avoid problems that hurt performance (Haspeslagh & Jemison, 1991; Lubatkin, 1983; Paine & Power, 1984; Zollo & Singh, 1998). Acquisitions create complex organizational challenges and organizational experience may be required to avoid problems (Haspeslagh & Jemison, 1991). For example, a firm's experience from past acquisitions may build facilitating processes for the identification (Hitt, *et al.*, 1998) and integration of target firm resources (Haspeslagh & Jemison, 1991). Effectively dealing with the challenges of acquiring high-technology target firms will likely be a function of an acquiring firm's experience. Stated another way, increased experience may build knowledge about how to perform acquisitions and

assimilate technology that would help firms avoid problems that hurt performance.

Therefore, the following is hypothesized:

Hypothesis 2: An acquiring firm's prior acquisition experience is positively related to post-acquisition financial performance for high-technology targets.

Form of Acquisition

The *form of an acquisition* involves the nature of the offer made by an acquiring firm with either a merger or a tender offer representing the primary alternatives (Berkovitch & Khanna, 1991). Tender offers involve proposals made directly to a target firm's shareholders through public bids, and mergers involve negotiations with a target firm's managers under conditions involving secrecy. Existing M&A research indicates that acquisitions completed as tender offers tend to outperform mergers (e.g., Berkovitch & Khanna, 1991; Rau & Vermealen, 1998). The explanation provided by Berkovitch and Khanna (1991) is that increased information disclosure from tender offers generates greater competition for a target firm that results in higher levels of post-acquisition performance.

An alternate explanation relevant to the acquisition of technology resources is that tender offers disclose more information (Weston, Chung & Siu, 1998) and increased information disclosure decreases the amount of uncertainty experienced by a target firm's employees (Daniel, 1999). Acquisitions create uncertainty for employees in target firms. This may lead to self-preservation in the form of behaviors that inhibit integration (Haspeslagh & Jemison, 1991). Uncertainty experienced by employees can erode job satisfaction, commitment and motivation (Ranft & Lord, 2002), and it can contribute to lower post-acquisition performance (Daniel, 1999; Larsson & Finkelstein, 1999). One

example of employee resistance to post-acquisition integration is voluntarily leaving a combined firm after an acquisition. This is particularly problematic in cases where acquisition success depends on retaining key people after an acquisition is completed (Daniel, 1999; Roberts & Berry, 1985; Ranft & Lord, 2002). Retaining employees is particularly relevant in the acquisition of high-technology targets where the tacit knowledge of R&D personnel is often far more valuable than any technology codified in a firm's patents (Bower, 2001; Dutta, Narasimhan & Rajiv, 1999).

Beyond retention, a high-technology target firm's employees must also voluntarily engage in knowledge sharing. Knowledge sharing occurs when individuals willingly cooperate and cooperation should increase with clarity of expectations and explanation of goals (Daniel, 1999; Kim & Mauborgne, 1998). Tender offers, in comparison to mergers, offer greater information disclosure facilitating retention and knowledge sharing that should lead to higher performance in a combined firm.

Therefore, the following is hypothesized:

Hypothesis 3: High-technology targets acquired through a tender offer positively impact post-acquisition financial performance.

Relative Size

Williamson (1975) hypothesized that an efficient approach to economic growth is having initial development and market testing performed by small firms, and then having larger firms acquire these firms and their successful developments. This view suggests that small firms may compensate for the disadvantages of large firms and vice versa (see Table 3). Large firms often possess more varied resources that can compensate for resource disadvantages in small firms. For example, large firms commonly possess greater manufacturing, marketing, sales, distribution, financial, and/or managerial

resources that small firms often need (Alvarez & Barney, 2001). On the other hand, small firms tend to have entrepreneurial and organic management styles characterized by risk acceptance, adaptability, flexibility, and open communications (Covin, Prescott & Slevin, 1990), and such qualities may help balance the effects of the bureaucratic and financial controls typical of large firms (Loescher, 1984). In summary, large firms tend to possess a greater breadth and depth of resources that may be more efficiently used by extending their use through an acquisition (Penrose, 1959).

It may also be easier for a larger firm to integrate resources from a smaller firm than from a firm of similar size (Alvarez & Barney, 2001; Clark & Ofek, 1994). This conclusion is due in part to decreased financial strain and integrative effort. However, improved acquisition performance may require that a target firm is large enough to achieve sufficient mass, while still remaining smaller than the acquiring firm (Kusewitt, 1985; Larsson & Finkelstein, 1999; Sharma & Kesner, 1996). In other words, an acquired firm may need to be large enough to impact the performance of a combined firm. If true, post-acquisition performance should increase when high-technology targets exhibit sufficient mass, while still remaining smaller than the acquiring firm.⁴ Therefore, the following is hypothesized:

Hypothesis 4: The relative size of a high-technology acquisition is positively related to post-acquisition financial performance.

⁴ Relative size is measured using a ratio of target firm market capitalization divided by an acquiring firm's market capitalization. A *t*-test comparing the ratio of target market capitalization divided acquiring firm market capitalization to a test value of 1 (e.g., equal target and acquiring firm size) indicates that target firms are significantly smaller than acquiring firms ($t = -50.52, p < .001$).

Table 3: Traditional Advantages and Disadvantages of Large and Small Firms ^a

<i>Resource</i>	<i>Large Firm</i>	<i>Small Firm</i>
Technology	<ul style="list-style-type: none"> - Unable to attract/retain research professionals with most current knowledge - Initial response to new technology is to improve existing technology + Multiple projects confer economies of scope 	<ul style="list-style-type: none"> + Able to attract/retain research professionals with most current knowledge + Responsive to adapting new technology - Often depend on success of single project
Marketing	<ul style="list-style-type: none"> + Recognized 'brand' connoting legitimacy 	<ul style="list-style-type: none"> - Lack of recognized brand, or legitimacy
Management	<ul style="list-style-type: none"> + Professional managers able to control complex organizations and establish corporate strategies - Can suffer from excess bureaucracy that hinders adaptation - Often focused on efficiency, or tend to be risk adverse 	<ul style="list-style-type: none"> - Entrepreneurial managers sometimes unable to cope with increasingly complex organizations + Lack of bureaucracy that facilitates adaptation + Entrepreneurial focus that embraces risk
Financial	<ul style="list-style-type: none"> + Ability to borrow on capital market + Ability to spread risk over a portfolio of projects + Able to fund growth via acquisition 	<ul style="list-style-type: none"> - Can experience difficulty in borrowing needed capital - Inability to spread risk over a portfolio of projects - Unable to fund growth via acquisition
Production	<ul style="list-style-type: none"> + Ability to gain scale economies + Ability to offer a range of complementary products 	<ul style="list-style-type: none"> - Capacity below most efficient scale - Inability to offer integrated product lines
Distribution	<ul style="list-style-type: none"> + Comprehensive distribution and service facilities 	<ul style="list-style-type: none"> - Limited distribution and service facilities

^a Note: Statements with a "+" represent advantages while those with a "-" represent disadvantages

Premium

Existing research suggests that the premium paid for a target firm is negatively correlated with an acquiring firm's financial performance (Hayward & Hambrick, 1997; Sirower, 1997). The common explanation for this finding is that firms overpay for

targets and that the premium paid for a target directly reduces the amount of post-acquisition performance that can be achieved. For example, the average premium paid for a target firm is approximately 40 percent (Jensen, 1993; Sirower, 1997) and this is sometimes offered as evidence that the net effect of M&A activity is positive. However, this assumes that the majority of the bargaining power in a transaction lies with the target, and that acquisition premiums are bid up to at least the break-even point for an acquiring firm (Eccles, Lanes & Wilson, 1999).

Lop-sided bargaining power is less likely to exist in high-technology acquisitions where the strengths and weaknesses of acquiring and target firms can complement one another. In acquisitions where both firms need the other firm, equal bargaining power will result from the exhibited interdependencies (Chatterjee, 1986). The result of acquisitions completed under conditions of approximately equal bargaining power should be a more even distribution of the expected benefits from a combination. An even distribution of benefits between a target and an acquiring firm should result in smaller acquisition premiums (Harrison, *et al.*, 1991) because the target firm has decreased bargaining power and is less able to appropriate the majority of gains. However, under conditions of equal bargaining power, the premium paid should also be below an acquiring firm's break even point. Therefore, the amount of premium paid should act as an indicator of post-acquisition performance, and the following relationship is hypothesized:

Hypothesis 5: The premium paid for a high-technology target is positively related to post-acquisition financial performance.

Interaction of Acquirer and Target R&D

As early as 1977, researchers have recognized that integration of external technology requires that a recipient firm have the ability to absorb the technology (Teece, 1977). The capacity to recognize and exploit external technology is a function of an acquiring firm's R&D intensity (Cohen & Levinthal, 1989, 1990; Nelson & Winter, 1978). Increased R&D intensity by a firm should lead a firm to be more proactive in exploiting external opportunities (Cohen & Levinthal, 1990; Tidd & Trehwella, 1997; Zahra & Covin, 1993), and improve a firm's ability to appropriate value from the acquired technology (Cohen & Levinthal, 1989, 1990; Deeds, 2001; Veugelers, 1997). However, while R&D intensity may be necessary, it may not be a sufficient condition for acquisition success.

Research by Capron and Pistre (2002) suggests that improved post-acquisition performance depends on the transfer or interaction between acquiring and target firm resources, and Bresman, Birkenshaw and Nobel (1999) found evidence that firms use acquisitions to gain access to R&D. An alternative interpretation is that R&D spending by firms makes them takeover targets because R&D represents an expense that an acquiring firm can cut to increase financial performance (Hitt, *et al.*, 1991; Hitt, *et al.*, 1996). However, R&D investments by a target firm may be valuable in their own right (Heeley, King & Covin, 2002).

A reasonable expectation is that the more R&D investments a target firm makes, the greater the number of resource combinations that will be possible in a combined firm. An increased number of R&D combinations after an acquisition should be positively associated with performance since greater R&D increases the chances a firm will develop

a technological innovation (Henderson & Cockburn, 1996; Nelson & Winter, 1978; Zahra, 1996). Additionally, the combined R&D resources of a firm after an acquisition should further increase its ability to adapt to changing markets (Zahra & Covin, 1993). Bresman, Birkenshaw and Nobel (1999) found evidence that firms make acquisitions to gain access to R&D, and a reasonable expectation is that the more R&D a target firm performed, the greater the number of value generating resource combinations that will be possible in a combined firm. In summary, the R&D investments made by a target firm should positively moderate the relationship between an acquiring firm's R&D intensity and its post-acquisition performance. Therefore, the following relationship is hypothesized:

Hypothesis 6: The R&D investments of a high-technology target firm will have a more positive relationship on post-acquisition financial performance when the acquiring firm is more R&D intensive.

Interaction of Acquirer Marketing and Target R&D

Marketing enables the commercialization of innovations by increasing the ability to recognize customer needs and improving the position of a firm relative to competitors (Dutta, Narasimhan & Rajiv, 1999; Moorman & Slotegraaf, 1999). From the perspective of an acquiring firm, marketing resources may also have qualities similar to a public good in that extending a brand to other applications does not diminish the underlying resource (Peteraf, 1993). Firms possessing brand recognition, for example, have the potential for reputation spillovers that can be applied to other products or markets (Teece, 1986; Wernerfelt, 1988).

Research suggests that marketing complements R&D (e.g., Dutta, Narasimham & Rajiv, 1999; Griffin & Hauser, 1996; Moenaert & Souder, 1996; Moorman & Slotegraaf,

1999; Temple, Veal & Smith, 1981; Tripsas, 1997). The complementary relationship may involve a reciprocal impact where marketing increases the value of R&D and R&D increases the value of marketing. Research provides at least two examples for how marketing resources can increase the value of R&D. First, an acquisition by a firm with an established brand may signal enhanced legitimacy of a target firm's product (Wernerfelt, 1988). Second, there is evidence that technology firms may fail to capitalize on their technical strengths unless those strengths are matched with aggressive marketing (Berry & Taggart, 1998; Brockhoff & Pearson, 1992). R&D resources can also increase the value of marketing by facilitating frequent product updates to meet customer demands (Milgrom & Roberts, 1990) or to adapt to external information (Cohen & Levinthal, 1990; Moorman & Slotegraaf, 1999). In summary, an acquiring firm's marketing resources should positively moderate the relationship between a target firm's R&D resources and its post-acquisition financial performance. Therefore, the following is hypothesized:

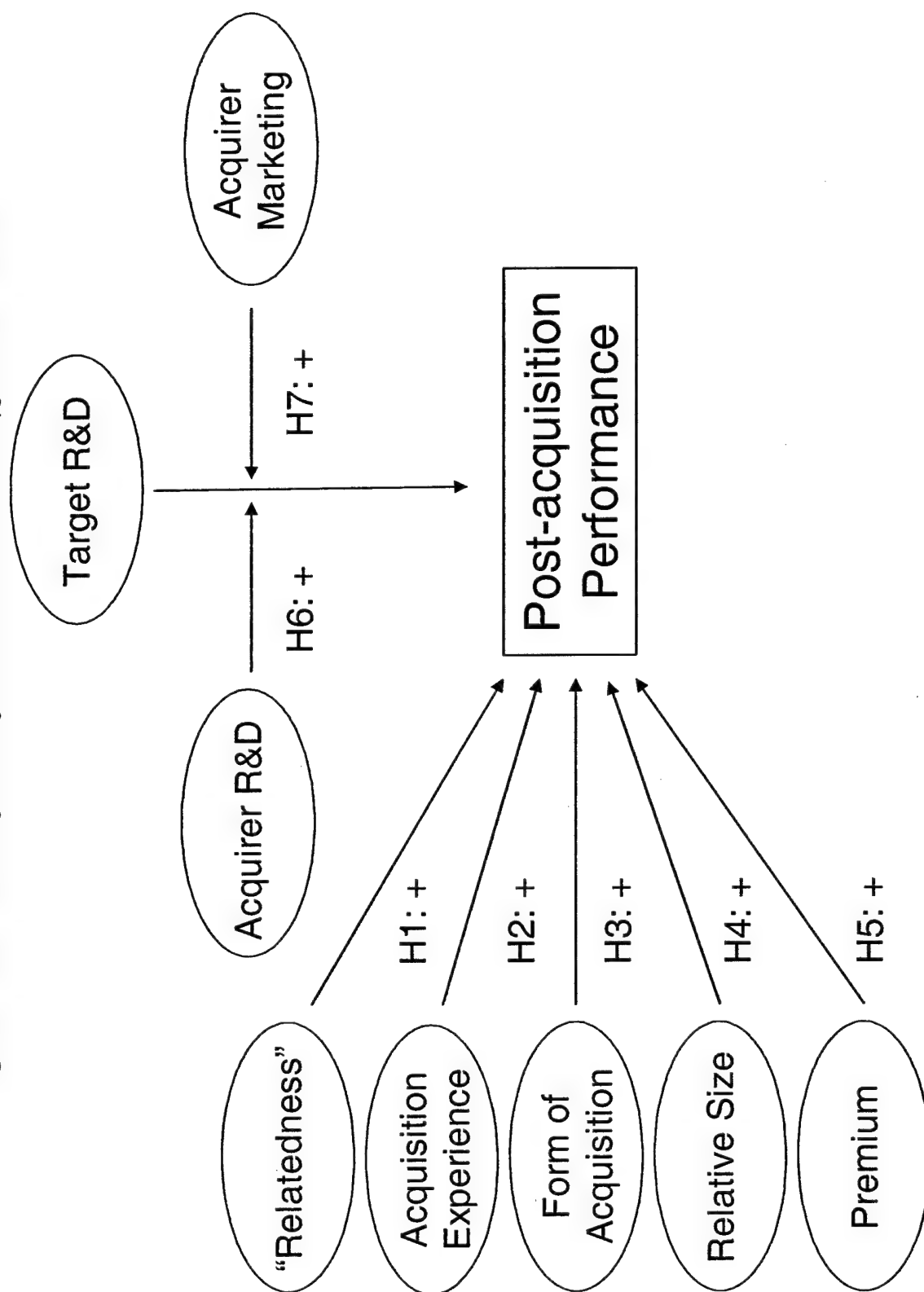
Hypothesis 7: The R&D resources of a high-technology target firm will have a more positive relationship on post-acquisition financial performance when the acquiring firm is more advertising intensive.

Summary

The preceding paragraphs developed a model and hypotheses designed to predict post-acquisition performance based largely on existing literature. However, hypotheses are developed specifically for the context of acquiring high-technology targets. The hypothesized relationships are summarized in Figure 2. The next chapter describes the research sample, the measurement of variables, and the types of analysis used to test the hypotheses. Additionally, control

variables without hypothesized effects that may reasonably impact post-acquisition performance are identified.

Figure 2: Model Predicting Post-acquisition Performance with Hypothesized Effects



CHAPTER 3

METHODOLOGY

In the following sections, the sample used to test the research hypotheses is presented along with a description of the measures. This is followed by a description of the statistical procedures used to test the hypotheses.

Sample and Data

The sample used for this study was limited to public, high-technology firms acquired between 1/1/1994 and 12/31/1997 with a market capitalization of \$10M or greater. Limiting the sample to this population of target firms is justified because it isolates acquisitions of a certain type and avoids studying a cross-section of M&A activity that may contain conflicting relationships with the research variables. Additionally, restricting the sample to this time frame helped control for known impacts of the business cycle on M&A activity (Ramanujam & Varadarajan, 1989; Lubatkin, *et al.*, 1997) by ensuring all performance measurement was limited to a period of favorable economic conditions.

High-technology target firms were identified by requiring that the sampled firms (i) displayed moderate R&D intensity prior to being acquired, and (ii) were in 2-digit industries commonly recognized as high-technology.⁵ Moderate R&D intensity was operationally defined for current purposes as firms having R&D-to-Sales ratios of two percent or greater. Selection of this value was based on rounding up from what has been reported as the overall industry average R&D-to-Sales figure of about 1.5 percent (e.g., Cohen & Klepper, 1992; Ravenscraft & Scherer, 1987). By choosing a figure above the

⁵ Using both R&D intensity and industry screens eliminated non-high technology industries such as woodworking machinery (SIC 3533) that otherwise may be included in a sample based only on 2-digit industry membership.

R&D-to-Sales average reported for all industries yet still close to that average, firms that could be objectively described as relatively R&D intensive were identified without unduly restricting the sample to only the most R&D intensive firms. The identification of targets in high-technology industries was determined from existing literature. Seven 2-digit industry sectors have been commonly recognized as high-technology industries: Chemicals [28], Computer Equipment [35], Electronics [36], the aerospace industry [Transportation: 37], Instruments [38], Communications [48], and the software industry [Business Services: 73] (e.g., Barringer & Bluedorn, 1999; Certo, *et al.*, 2001; Himmelberg & Petersen, 1994; Steensma & Corley, 2001). A \$10M market capitalization restriction was consistent with the lower bound observed in previous acquisition research (e.g., Finkelstein, 1997; Ranft & Lord, 2002; Ravenscraft & Scherer, 1987) and was intended to ensure target firms were large enough to impact acquiring firm performance.⁶ After applying these screens, a census of 312 high-technology target firms was identified. Two additional restrictions were applied to identify the final sample.

First, acquisitions were eliminated if target and acquiring firm's Standard Industrial Classification (SIC) code was not identified by *COMPUSTAT* to the 4-digit SIC level.⁷ This step controlled for industry effects and allowed the use of a categorical

⁶ The use of a \$10 million market capitalization cut-off in research appears to carry over from the reporting criterion adopted by the Federal Trade Commission (FTC) in its large merger series commonly used in M&A research which has been neither collected nor updated since 1979 (Brush, 1996; Finkelstein, 1997). This is relevant, because due to the impacts of inflation a \$10 million cut-off results in the inclusion of smaller target firms than previous research and should have a conservative impact by including acquired firms that are smaller and less likely to impact acquiring firm performance. For example, assuming an average rate of inflation of 4 percent, a \$10 million market capitalization in 1979 is equal to a market capitalization of \$4.8 million in 1997.

⁷ Kahle and Walkling (1996) describe how *COMPUSTAT* assigns SIC codes. In brief, *COMPUSTAT* analysts assign an SIC code that in their opinion best describes a company's business. If a company is involved in more than one aspect of an industry it is assigned a more general 2-digit code with more

entropy diversification measure for firm relatedness. Limiting the sample to target and acquiring firms identified at the 4-digit level also helped control for the potential confounding effects of conglomerate firms.

Second, the sample of acquiring firms had to be available in the *Center for Research on Security Prices (CRSP)* database to allow calculation of several research variables (e.g., Jensen's alpha, the premium paid for a target firm, relative size). The final sample was comprised of 133 pairs of firms (see Appendix B).

Measures

This section explains the operationalization for each variable beginning with the dependent firm performance variables. Following this the independent variables and control variables are defined.

Financial Performance

Keats (1988) found that stock and accounting performance measures represent different dimensions of firm financial performance. Therefore, both stock and accounting measures of financial performance were used in the present research. In both cases, a three-year time frame was used to measure firm performance because the time frame was consistent with common practice in other acquisition studies (e.g., Carper, 1990; Long & Ravenscraft, 1993; Ramaswamy, 1997). Prior research also suggests that three years is sufficient to observe changes in firm performance after an acquisition (Ingham, Kran & Lovestam, 1992; Lubatkin *et al.*, 2001). Specifically, the present research uses Jensen's alpha as a measure of stock performance and Return-on-Sales

specific 3 and 4 digits simply entered as zero. A full 4-digit code is only used when warranted, or when the primary focus of a company is in a single industry. Additionally, Kahle and Walkling (1996) compare samples matched on *COMPUSTAT* and *CRSP* SIC codes and conclude that the use SIC codes assigned by *COMPUSTAT* are more powerful in detecting abnormal performance.

(ROS) as an accounting measure of a firm's profitability.⁸ The operationalization of each measure is described separately below.

Stock Measure. Jensen's alpha (Alexander & Francis, 1986; Jensen, 1968), a variation of the two-parameter market model, was used to measure an acquiring firm's abnormal returns. For each month after an acquisition ($t = 1$ to 36) the following regression model was calculated:

$$R_{it} = \alpha_i + \beta_i(R_{mt}) + \varepsilon_{it}$$

where:

R_{it} is the monthly rate of return of firm i during month t

α_i is Jensen's alpha for firm i

β_i is a firm i 's stock price variance relative to the variance of the market benchmark (m)

R_{mt} is the monthly rate of return of the market benchmark (m) during month t

ε_{it} is the random error term

As the regression intercept, Jensen's alpha measures the average difference between the market benchmark's return and the return of the firm (Alexander & Francis, 1986), or abnormal return. If Jensen's alpha is not significantly different from zero, then a firm's stock performance is the same as the market benchmark. Once calculated for each firm, Jensen's alpha is used as the dependent variable in a cross-sectional regression model to test the hypothesized effects. This application of cross-sectional regression allows the association between an event and abnormal returns to be observed (Campbell, Lo & MacKinlay, 1997). Individual firm stock and market benchmark monthly rates of return were collected from the *CRSP* database with the *S&P500*® index serving as the market benchmark. Hoskisson, *et al.* (1993), Hoskisson, Johnson and Moesel (1994) and

⁸ ROS was used instead of Return-on-Assets (ROA) because the method of accounting for acquisitions directly biases ROA (Ravenscraft & Scherer, 1987), and ROS is not affected by the method of accounting for an acquisition (Barber & Lyon, 1996; Markides & Williamson, 1994). Additionally, ROS has been found to be an evaluation criterion used by managers (Ingham, *et al.*, 1992).

Farjoun (1998) have previously employed Jensen's alpha as a measure of firm performance.

Accounting measure. The impact of an acquisition on firm performance was also tested using a firm's profitability. Bild (1998) has raised questions about whether assumptions underlying the comparison of an acquiring firm's profitability to external benchmarks are valid. Additionally, studies that only measure a firm's average level of profitability after an acquisition (e.g., Hopkins, 1987; Krishnan, Miller & Judge, 1997; Ravenscraft & Scherer, 1989) fail to detect how a firm's profitability changes after an acquisition. Therefore, whether an acquisition increases firm profitability after an acquisition is tested allowing a firm's own performance to serve as a benchmark. The average percentage change in an acquiring firm's industry-adjusted profitability is calculated for the three years following an acquisition. Data from the year of an acquisition was excluded from data gathering, similar to Healy, Palepu and Ruback (1993), to control for the disruptive effects of an acquisition in the year it was made.

Similar to Stimpert and Duhaime (1997), an acquiring firm's profitability is adjusted to help control for industry effects (Dess, Ireland & Hitt, 1990). Acquiring firm industry-adjusted profitability was measured by subtracting the average ROS for firms in an industry from an acquiring firm's ROS. ROS was calculated for three years following an acquisition, and was obtained from *COMPUSTAT* [net income (data code 18) divided by sales (data code 12)].

Independent Variables

Relatedness. The relatedness of an acquisition was measured using a categorical entropy measure (Harrison, *et al.*, 1991; Hoskisson, *et al.*, 1993; Hayward & Hambrick,

1997) where relatedness varied based on the degree of match between the target and acquiring firm primary 4-digit SIC codes. When all four SIC digits matched for an acquiring and target firms' primary SIC code, a relatedness value of 3 was assigned. Similarly, when the first three digits matched, relatedness = 2, and, when the first two digits matched, relatedness = 1. An unrelated acquisition (relatedness = 0) was defined as the acquisition of a target firm in a 4-digit SIC outside an acquiring firm's 2-digit industry group because the first digit of an SIC code is meaningless with manufacturing industry 2-digit SIC codes ranging between 20 and 39.

Acquisition Experience. Acquisition experience was operationalized similar to Hayward (2002) with an acquiring firm's acquisition experience recorded as the sum of the number of acquisitions that the firm completed in the previous three years. Prior acquisition experience was identified using the *Security Data Corporation (SDC)* database.

Form of Acquisition. The form of acquisition (i.e., merger or tender offer) was measured using a dichotomous dummy variable (merger = 0 and tender offer = 1). Information on the form of an acquisition was retrieved from either the *SDC* database or an online search of business press. The use of business press has been used in the past to define variables in academic research (e.g., Hambrick & Crozier, 1985; Hayward & Hambrick, 1997; Hitt, *et al.*, 1998).

Relative size. The relative size of firms was calculated similar to Seth (1990b) and Sirower (1997) as the ratio of target firm market capitalization divided by acquiring firm market capitalization. Market capitalization for target and acquiring firms four weeks prior to an acquisition announcement was used to calculate the relative size ratio.

Market capitalization data was obtained from the *SDC* database or calculated from the *CRSP* database. The announcement date of an acquisition was identified using the *SDC* database or through an online search of business press.

Premium. Similar to Hayward and Hambrick (1997), the premium paid for a target firm was defined as the purchase price minus the pre-acquisition price. The purchase price was identified from either the *SDC* database or an online search of business press. The pre-acquisition price was defined as the market capitalization of a target firm four weeks prior to an acquisition announcement from the relative size calculation above.

Target R&D. A target firm's ability to perform R&D is built over time through cumulative investments in R&D that are subject to depreciation as technology continues to advance. As this implies, more recent investments in R&D are more valuable (Dierickx & Cool, 1989). Therefore, similar to Griliches and Mairesse (1984), a cumulative R&D measure of a target firm's R&D investments was depreciated by 15 percent per year for three years. Data on a target firm's R&D expenditures was obtained from *COMPUSTAT* [data code 46].

Acquirer R&D. The intensity of a firm's R&D corresponds to its ability to recognize, assimilate, and convert new information to commercial ends (Cohen & Levinthal, 1989, 1990). To control for industry effects (Dess, Ireland & Hitt, 1990), R&D intensity of an acquiring firm was defined similar to Cohen and Levinthal (1989, 1990) as a firm's R&D intensity minus the average R&D intensity of firms in its industry. The resulting relative R&D intensity measure was averaged for the prior three years to represent a firm's level of commitment (Dierickx & Cool, 1989) to R&D, while

controlling for annual variation. Firm and industry R&D intensity were calculated using data available from *COMPUSTAT* [R&D expenditures (data code 46) divided by sales (data code 12)]. Industry R&D intensity was calculated from *COMPUSTAT* by calculating the average R&D intensity for all firms with the same 4-digit SIC code. Acquiring firms that did not report R&D expenditures were assumed to have no such expenditures.

The hypothesized interaction between acquirer and target R&D was examined by multiplying each measure together, resulting in an indicator used to test their combined effect on post-acquisition performance. Any independent effect of acquirer or target was controlled for by including the variables in a separate regression model.

Acquirer Marketing. Acquirer marketing was measured using an acquiring firm's advertising intensity. To control for industry effects (Dess, Ireland, & Hitt, 1990), advertising intensity was measured similar to Stimpert and Duhaime (1997) as an acquiring firm's advertising expenses divided by sales, minus the average advertising intensity of firms in its industry. The resulting relative advertising intensity measure was averaged for the prior three years to control for annual variation and to provide a consistent indication of a firm's level of commitment. Firm and industry advertising intensity was calculated from *COMPUSTAT* [data codes 45 (advertising expenditures) and 12 (sales)]. Missing values for an acquiring firm's advertising expenditures were assumed to be zero, which should have a conservative impact on the hypothesized relationship by making it less significant.

The hypothesized interaction between acquirer marketing and target R&D was tested by multiplying each measure together, resulting in an indicator used to test their

combined effect on post-acquisition performance. Any independent effect of acquirer marketing or target R&D was controlled for by including the variables in a separate regression model.

Control Variables

The most common post-acquisition performance variables identified in Table 2 not associated with hypothesized effects were used as control variables.⁹ Additional variables were also included to control for an acquiring firm's industry environment, the year of acquisition, and industry type.

Financial Resources. The level of an acquiring firm's financial resources was measured using a relative current ratio measure. In the year prior to an acquisition, the acquiring firm's current ratio minus the average current ratio for firms in its industry was defined as the relative current ratio. Firm and industry current ratios were calculated from *COMPUSTAT* [data code 4 (current assets) divided by data code 5 (current liabilities)].

Target Firm Profitability. It is reasonable that a target firm's financial performance may be systematically related to its R&D spending (e.g., DeCarolis & Deeds, 1999; Grabowski & Vernon, 1990) and the likelihood it will become an acquisition target (e.g., Bruton, Oviatt & White, 1994; Vermeulen & Barkema, 2001). Therefore, target firm profitability was used as a control variable and is measured as a target firm's ROS (i.e., Data Code 18 divided by Data Code 12, in the year prior to it being acquired).

⁹ An exception is the friendliness of an acquisition because essentially all the acquisitions in the current sample were friendly. In general hostile acquisitions, where the offer is rejected by a target firm's board of directors, are infrequent. For example, only 172 acquisitions out of 35,000 acquisitions completed between 1976 and 1990 were hostile acquisitions (Jensen, 1993).

Acquiring Firm Profitability. It is also reasonable that an acquiring firm's performance prior to an acquisition may be related to its post-acquisition performance. Therefore, an acquiring firm's profitability was controlled for by calculating its ROS in the year prior to an acquisition.

Method of Accounting. The method of accounting for an acquisition was controlled for using a dichotomous dummy variable (pooling = 0 and purchase = 1).¹⁰ Under pooling of interests, assets of an acquired firm are recorded at their pre-acquisition book value and the difference in amount paid for a firm is either debited or credited to acquirer's stockholders equity account (Ravenscraft & Scherer, 1987). Conversely, under purchase accounting, acquired assets are entered at the effective price paid (Ravenscraft & Scherer, 1987). Pooling of interest accounting is significantly associated with higher acquisition premiums (Ravenscraft & Scherer, 1987) and the premium paid has been found to impact post-acquisition performance (Hayward & Hambrick, 1997; Sirower, 1997). Information on method of accounting was identified from either *SDC* database or an online search of business press (see "acquisition experience" above for justification of the use of business press).

Acquiring Firm Environment. Research supports viewing a firm's environment as a multidimensional construct with three dimensions: munificence, dynamism, and complexity (e.g., Bluedorn, 1993; Dess & Beard, 1984; Keats & Hitt, 1988; Pfeffer & Salancik, 1978; Sharfman & Dean, 1991). The dimensions of a firm's environment were controlled for by measuring these variables using the procedures described by Keats and Hitt (1988).

¹⁰ The Financial Accounting Standards Board eliminated pooling of interests accounting and modified recording of goodwill with purchase accounting for all acquisitions completed after July 1, 2001 (Weil, 2001).

Munificence relates to the scarceness of environment resources that support firm growth in a given industry (Dess & Beard, 1984; Pfeffer & Salancik, 1978; Sharfman & Dean, 1991). This environmental dimension has been discussed within the population ecology literature under the label of environmental carrying capacity (Aldrich, 1979). Munificence is characteristically assumed to have a positive net effect on firm performance (DeCarolis & Deeds, 1999), and it was calculated as the average of the coefficient estimates from two separate regression models of a 4-digit industry's net sales and operating income over the preceding five-year period, with time serving as the dependent variable.

Dynamism corresponds to uncertainty or the degree of instability and unpredictable change in an industry (Dess & Beard, 1984; Pfeffer & Salancik, 1978; Sharfman & Dean, 1991). More dynamic industries are normally associated with lower levels of performance, and dynamism was calculated as the average of the standard errors for net sales and operating income from the two munificence regression equations.

Complexity relates to the number and diversity of other organizations with which a firm must interact (Dess & Beard, 1984; Pfeffer & Salancik, 1978). Complexity is reflected in such factors as the breadth and variety of a firm's geographic markets, customers, suppliers, and competitors. In general, fragmented industries are regarded as more complex than concentrated industries (Keats & Hitt, 1988). Complexity was calculated using a market concentration measure computed by regressing the terminal-year (i.e., year five) market shares of the firms in a given 4-digit industry on these firms' initial-year (i.e., year one) market shares. Note that lower values on the complexity scale signify *higher* levels of complexity.

Year. The year, or time impact, of an acquisition was controlled for using a polychotomous dummy variable with the year 1994 serving as the reference year. The year of an acquisition was obtained from *COMPUSTAT* using the year the target firm was acquired [variable AFTNT 34]. Including the year of acquisition controls for whether the timing of an acquisition impacts performance, and helps signal if pooling cross-sectional data over several years satisfied the regression analysis assumption of homogeneous variance.

Industry Type. Existing acquisition research focuses almost exclusively on the acquisition of target firms operating in manufacturing industries (Empson, 2000). The current sample contained both manufacturing and services firms. It is reasonable that variables included in the study may have a differential impact in relation to manufacturing versus service industry targets. Therefore, a dichotomous dummy variable was used to control for target *industry type* (0 = manufacturing, and 1 = service) and to determine whether the results can generalize to both manufacturing and service industries

Analysis

Initial analysis involved calculating and reporting variable descriptive statistics and correlations. Moderated multiple regression was then used to test the hypothesized relationships. Moderated multiple regression is recommended for detecting moderated relationships (Sharma, Durand & Gur-Arie, 1981). The incremental contributions of the control variables, independent variable main effects, and interaction effects were analyzed in a forward step-wise fashion. Finally, all predictor variable coefficients were standardized to facilitate interpretation of the results (Aiken & West, 1991).

Summary

The design used in this study to test hypothesized relationships between variables and post-acquisition performance represents several methodological improvements. The sample was limited to firms that acquired high-technology targets, or a certain type of acquisition. Additionally, data collection and analysis includes the most common M&A research variables to avoid model under-specification. The study also meets recognized research needs by including multiple measures of firm performance and interaction effects. The following chapter presents the analytical results.

CHAPTER 4

RESULTS

The means, standard deviations, and correlations for research variables are shown in Table 4. Consistent with existing research (e.g., Datta, *et al.*, 1992; King, *et al.*, 2002) the acquiring firm's stock performance was not positively impacted, on average. The mean of the Jensen's alpha measure produced an abnormal return of zero. Additionally, only three correlations in Table 4 are greater than 0.8, the level Gujarati (1995: 335) associates with multicollinearity becoming a problem.¹¹ As discussed later, entering variables in different steps allows the comparison of results across models to help detect multicollinearity.

Five separate regression models were calculated in a forward step-wise fashion for each measure of financial performance. The control variables were entered in Model 1 to determine whether any of the control variables and resulting model provided significant explanatory power. Next, the main effects related to the hypothesized interactions (i.e., Hypothesis 6 and 7) were entered into Model 2. Variables predicted to have significant independent effects were entered into Model 3. Finally, in Models 4 and 5 variables relating to the hypothesized interactions were entered separately and compared to Model 3 to identify their unique effects. The results for the stock and accounting measures of financial performance are presented separately.

¹¹ Importantly, the impact of multicollinearity on regression analysis has a conservative impact and results in decreased efficiency or ability to detect significant parameter estimates, without impacting the ability of regression to provide unbiased parameter estimates (Griffiths, Hill & Judge, 1993).

Table 4: Variable Means, Standard Deviations, and Correlations^a

Variable	Mean	Std Dev	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Jensen's Alpha	-0.001	0.024	1													
2 Change in profitability ^b	605.136	1349.923	0.170*	1												
3 1995 ^c	0.280	0.457	-0.093	-0.029	1											
4 1996 ^c	0.242	0.430	-0.124	0.112 [†]	-0.353**	1										
5 1997 ^c	0.318	0.468	0.162	0.009	-0.426**	0.386**	1									
6 Interaction of Acquirer Marketing and Target R&D	-4.76E+06	2.17E+07	0.001	0.050739	-0.023	0.059	0.081	1								
7 Interaction of Acquirer and Target R&D	-2.63E+08	1.61E+09	-0.081	0.041	-0.107	0.055	0.037	0.177*	1							
8 Acquirer Financial Resources	-1.716	3.479	0.111	0.039	0.039	0.177	-0.040	-0.062	0.101	1						
9 Acquirer Marketing	-0.112	0.458	-0.009	0.069	-0.103	0.068	0.099	0.852**	-0.019	-0.078	1					
10 Acquirer Complexity	0.813	0.295	0.115	0.061	-0.098	0.174	0.113	0.107	0.020	0.042	0.131	1				
11 Acquirer Dynamism	1.033	0.036	-0.060	-0.006	-0.244**	0.247**	-0.033	0.063	0.040	0.051	0.045	-0.060	1			
12 Acquirer Munificence	1.188	0.140	0.126	0.017	-0.207*	-0.031	0.150	-0.016	-0.002	0.136	0.041	-0.080	0.075	1		
13 Acquirer Profitability	0.034	0.345	-0.026	0.073	-0.044	-0.084	0.121	-0.052	-0.055	-0.126	-0.050	-0.007	0.143	0.067	1	
14 Acquirer R&D	-2.978	5.583	-0.009	0.039	-0.069	0.026	0.055	0.011	0.355**	0.239**	-0.050	0.046	0.169	0.090	-0.034	1
15 Acquisition Experience	1.129	1.565	0.011	0.245**	-0.095	0.214	0.048	0.060	0.033	-0.104	0.066	0.200*	-0.113	0.076	0.133	-0.032
16 Method of Accounting ^d	0.485	0.502	0.057	0.158*	0.002	-0.018	-0.077	0.080	-0.135	-0.070	0.074	-0.169	0.173	-0.014	0.070	-0.083
17 Acquisition Form	0.205	0.405	0.111	0.210**	0.018	-0.068	0.016	-0.216*	-0.248	-0.148	-0.155	-0.135	0.009	-0.024	0.147	-0.073
18 Industry Type ^e	0.303	0.461	-0.003	-0.137 [†]	0.102	-0.104	0.010	-0.198*	0.102	0.168	-0.266	-0.116	-0.032	0.132	0.037	0.293**
19 Premium ^b	1539.242	12791.42	0.074	-0.029	0.133	-0.043	-0.051	-0.146	-0.920**	-0.076	0.016	0.009	-0.067	-0.045	0.056	-0.171*
20 Relatedness	1.818	1.301	0.150	-0.270**	0.062	-0.193	0.071	-0.120	-0.111	0.124	-0.050	-0.079	-0.128	0.099	0.012	-0.103
21 Relative Size	0.091	0.204	0.236**	-0.082	0.040	-0.039	0.021	-0.071	-0.128	0.000	0.025	0.074	-0.100	0.037	-0.053	-0.093
22 Target Profitability	-46.393	185.564	-0.032	0.058	-0.008	0.007	0.047	-0.040	0.042	-0.062**	-0.041	0.043	0.082	0.023	0.417**	0.262**
23 Target R&D ^f	4.77E+07	1.42E+08	0.003	0.040	0.024	-0.061	0.074	-0.173	-0.719**	0.101	0.014	-0.025	-0.016	-0.063	0.059	-0.135

^a n = 133 firms^b \$'s in Millions^c Dummy variable with 1994 as reference year; mean represents proportion of firms completing an acquisition that year^d Mean represents proportion of acquisitions completed using purchase accounting^e Mean represents proportion of target firms operating in a service industry^f in \$'s* $p < .05$ ** $p < .01$

Table 4: Continued

Variable	15	16	17	18	19	20	21	22
15 Acquisition Experience	1							
16 Acquisition Type	-0.051	1						
17 Acquisition Form	-0.054	0.485**	1					
18 Industry Type	-0.033	-0.178	-0.048	1				
19 Premium	0.006	0.079	0.173*	-0.065	1			
20 Relatedness	-0.187*	-0.180	-0.117	0.143	0.085	1		
21 Relative Size	-0.005	-0.175	-0.064	0.029	-0.007	0.048	1	
22 Target Profitability	0.091	-0.004	0.066	0.167	0.039	-0.012	-0.009	1
23 Target R&D	0.048	0.029	0.198	-0.118	0.737**	0.183*	0.043	0.026

* $p < .05$ ** $p < .01$

Stock Measure

Regression results for the stock measure of performance are shown in Table 5. Although Model 1 was not statistically significant, the results indicate that acquisitions completed for 1995 and 1996 experienced significantly lower returns than the reference year 1994. Therefore, a potential concern for interpreting the regression results involves whether pooling acquisition activity from different years violates the regression assumption of homoskedasticity, or equal variance. Supplementary analysis using the Goldfeld-Quandt *F*-test (Griffiths, Hill and Judge, 1993) showed none of the year-year and full model combinations are significant. This suggests that variance across the different years is homoskedastic and regression analysis is appropriate.

Neither the model nor any of the additional variables entered in Model 2 was significant. This result supports the conclusion that modeled interaction variable terms do not have independent effects or do not contribute to improved post-acquisition performance on their own.

Both the overall model and change in R-square were significant for Model 3, the first model with hypothesized effects. Hypothesis 1, which predicted that target-acquiring firm relatedness would be positively related to post-acquisition performance, was supported ($p < .05$). The anticipated positive relationship of an acquiring firm's acquisition experience in Hypothesis 2 was not supported, since the coefficient, while positive, was not statistically different from zero. Hypothesis 3 was marginally supported ($p < .10$) suggesting that the information disclosure associated with tender offers, in comparison to mergers, is positively related to post-acquisition performance. The impact of target firm size, Hypothesis 4, was strongly supported ($p < .01$) indicating that

acquiring smaller firms of sufficient mass have a positive impact on post-acquisition performance. Finally, the impact of the premium paid for a target firm has a significantly positive impact ($p < .05$) on post-acquisition performance. This result strongly supported Hypothesis 5.

Table 5: Multiple Regression Results for Predicting Abnormal Returns ^a

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Acquirer Munificence	0.085	0.089	0.042	0.062	0.054
Acquirer Dynamism	-0.063	-0.055	0.002	0.023	-0.004
Acquirer Complexity	0.154*	0.161*	0.133 [†]	0.136 [†]	0.138 [†]
Acquirer Profitability	-0.004	-0.012	-0.026	-0.024	-0.026
Acquirer Financial Resources	0.164*	0.168*	0.163*	0.175*	0.176*
Method of Accounting	0.102	0.103	0.078	0.091	0.061
Target Profitability	-0.069	-0.061	-0.086	-0.103	-0.087
1995	-0.163 [†]	-0.166 [†]	-0.191 [†]	-0.198 [†]	-0.241*
1996	-0.220*	-0.220*	-0.218 [†]	-0.224*	-0.244*
1997	-0.007	-0.005	-0.002	-0.004	-0.039
Industry Type	-0.003	0.000	-0.045	-0.036	-0.051
Acquirer R&D		-0.035	0.040	-0.040	0.035
Acquirer Ad. Intensity		-0.032	-0.021	-0.019	-0.284*
Target R&D		0.020	-0.223*	-0.195 [†]	-0.187 [†]
Relatedness (H1)			0.174*	0.175*	0.187*
Acquisition Experience (H2)			0.096	0.083	0.097
Acquisition Form (H3)			0.158 [†]	0.188*	0.188*
Relative Size (H4)			0.225**	0.305**	0.280**
Premium (H5)			0.229*	0.563*	0.251*
Interaction of Acquirer and Target R&D (H6)				0.402 [†]	
Interaction of Acquirer Marketing and Target R&D (H7)					0.313*
R ²	0.100	0.102	0.212	0.225	0.232
Change in R ²		0.002	0.110*	0.013 ^b	0.020 ^{†,b}
Adjusted R ²	0.017	-0.005	0.078	0.085	0.094
F	1.211	0.953	1.586 [†]	1.611 [†]	1.680*

^a n = 133, standardized coefficients

^b Compared to Model 3

[†] $p < .10$, one-tailed

* $p < .05$, one-tailed

** $p < .01$, one-tailed

The results of Model 4 were also significant. Hypothesis 6, the interaction between acquirer and target firm R&D, was marginally supported ($p < .10$). This result suggests that interactions between acquirer and target firm investments contribute to increased post-acquisition performance.

Both the overall model and change in R-square for Model 5 were significant. The interaction between acquirer marketing and target R&D, predicted in Hypothesis 7, was supported ($p < .05$). This result further supports the conclusion that interactions between acquirer and target firm investments contribute to increased post-acquisition performance, and that individual firm attributes are not always sufficient for improved post-acquisition performance.

Comparisons made across the regression models in Table 5 indicate that multicollinearity was not a problem because coefficients and their respective levels of significance remain stable across the models (Griffiths, Hill & Judge, 1993). Additionally, calculated collinearity statistics (tolerance and variance inflation factor) indicated that multicollinearity may have affected the efficiency for acquisition experience and the hypothesized interactions only. Both hypothesized interactions (H6 and H7) were significant (at least, $p < .10$) however, indicating that the hypothesized effect overcame any decrease in efficiency related to multicollinearity. Without the impact of multicollinearity the observed effects may have been even more significant.

To conclude the stock performance results, it is interesting to note that even though Models 4 and 5 included the largest number of variables they exhibited the largest adjusted R-square and the highest level of significance for modeled relationships. This

indicates that under-specification in prior research is a reasonable concern.¹² The results for predicting post-acquisition stock performance are summarized in Table 6.

Table 6: Summary of Results for Predicting Post-acquisition Abnormal Returns

Hypothesis	Observed Result
Relatedness (H1)	Supported, $p < .05$
Acquisition Experience (H2)	Not supported
Acquisition Form (H3)	Supported, $p < .05$ (Models 4 & 5)
Relative Size (H4)	Strongly supported, $p < .01$
Premium (H5)	Supported, $p < .05$
Interaction of Acquirer and Target R&D (H6)	Marginally supported, $p < .10$
Interaction of Acquirer Marketing and Target R&D (H7)	Supported, $p < .05$

Accounting Measure

Results for the accounting measure of post-acquisition performance are presented in Table 7. Model 1 was not statistically significant and acquirer profitability was the only variable with a significant coefficient in each of the different models. The results of Model 2 were also not significant. However, an acquiring firm's R&D intensity had a significantly positive effect ($p < .10$) on post-acquisition profitability. Acquiring firm R&D intensity was the only acquiring or target firm resource that appeared to have an independent effect.

Neither the overall model nor the change in R-square was significant for Model 3, the first model with hypothesized effects. Hypothesis 1, which predicted that target-acquiring firm relatedness would be positively relate to post-acquisition profitability, was not significant. Moreover, the coefficient's sign was opposite the hypothesized direction. The anticipated relationship of an acquiring firm's acquisition experience in Hypothesis 2 was not supported, since the coefficient, while positive, was not statistically different

¹² The R-square in the present research exceeded the level of variance usually explained by M&A research. By comparison, "Empirical studies generally explain less than 10 percent of variance in the shareholder performance of acquiring firms" (Sirower, 1997: 158).

from zero. Hypothesis 3 was not supported suggesting that the information disclosure associated with tender offers does not impact post-acquisition profitability growth. The impact of target firm size, Hypothesis 4, was not supported indicating that relative size does not affect changes in post-acquisition profitability. The impact of the premium paid for a target firm, Hypothesis 5, was also not supported.

Table 7: Multiple Regression Results for Predicting Post-acquisition Profitability^{a, b}

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Acquirer Munificence	0.019	0.02	0.014	0.017	0.013
Acquirer Dynamism	-0.016	0.039	-0.036	-0.033	-0.036
Acquirer Complexity	-0.017	-0.021	-0.037	-0.037	-0.037
Acquirer Profitability	0.205*	0.222*	0.231*	0.232*	0.231*
Acquirer Financial Resources	-0.103	-0.122	-0.112	-0.110	-0.112
Method of Accounting	0.067	0.076	0.125	0.127	0.125
Target Profitability	-0.017	-0.049	-0.055	-0.058	-0.055
1995	0.019	0.029	0.022	0.021	0.023
1996	0.096	0.110	0.088	0.087	0.089
1997	-0.094	-0.088	-0.097	-0.097	-0.096
Industry Type	-0.107	-0.150	-0.148 [†]	-0.147 [†]	-0.148 [†]
Acquirer R&D		0.137 [†]	0.142 [†]	0.129	0.143 [†]
Acquirer Marketing		-0.055	-0.072	-0.072	-0.066
Target R&D		0.015	0.050	0.055	0.05
Relatedness (H1)			-0.046	-0.046	-0.046
Acquisition Experience (H2)			0.048	0.046	0.048
Acquisition Form (H3)			-0.076	-0.071	-0.077
Relative Size (H4)			0.112	0.120	0.111
Premium (H5)			-0.027	0.028	-0.028
Interaction of Acquirer and Target R&D (H6)				0.067	
Interaction of Acquirer Marketing and Target R&D (H7)					-0.008
R ²	0.093	0.110	0.130	0.131	0.130
Change in R ²		0.017	0.020	0.001 ^b	0.000 ^b
Adjusted R ²	0.011	0.005	-0.016	-0.024	-0.025
F	1.130	1.045	0.892	0.843	0.840

^a n = 133, standardized coefficients

^b Compared to Model 3

[†] p < .10, one-tailed

* p < .05, one-tailed

The results of Model 4 and Model 5 do not support an interaction between acquirer and target pre-acquisition investments. In other words, the interaction variable was not associated with increased post-acquisition profitability. In Model 4, Hypothesis 6, the interaction between acquirer and target R&D, was not supported. Model 5 was not significant, and Hypothesis 7, the interaction between acquirer marketing and target R&D, was not supported. The results for post-acquisition profitability did not support any of the hypothesized relationships and have very little, if any, explanatory power.

Summary

Analytical results for different measures of firm performance show mixed results for the hypothesized relationships between research variables and post-acquisition performance. Results using a long-term measure of acquiring firm stock performance largely support research hypotheses, while results using a profitability measure of acquiring firm performance do not. Importantly, results using a long-term stock market measure of post-acquisition performance display a significant increase in the amount of variance in post-acquisition performance explained, and appear to overcome any limitations associated with multicollinearity. Implications of this study's results are the focus of the following chapter.

CHAPTER 5

DISCUSSION AND CONCLUSION

The present study represents a contribution to what is currently known about predicting post-acquisition performance. The amount of explained variance in post-acquisition stock performance in the current study is approximately twice that of prior post-acquisition performance research, which generally explained only 10 percent of the variance in stock price (Sirower, 1997: 158). The only studies we reviewed that have comparable R-square values are Ravenscraft and Scherer (1987, 1989) with R-squares ranging from .18 to .24 from a cross-sectional sample of 2,732 acquisitions between 1957 and 1997, and Hayward (2002) with R-squares ranging from .22 to .46 from a sample restricted to 214 acquisitions made by the 100 largest U.S. public firms between 1985 and 1995. The relatively large R-square achieved here with a sample of only 133 observations may be the result of a number of factors. First, this study included careful methodological controls such as restricting the sample to a certain type of acquisition. Second, by including the most common M&A research variables in the research model, the impact of model under-specification was limited. Third, the study used a long-term measure of an acquiring firm's stock performance. Fourth, the study tested the interaction of acquiring and target firm variables. Fifth, the sampling time frame controlled for the impact of the business cycle on M&A activity by limiting it to a period of favorable economic conditions. Sixth, the sample was limited to non-diversified firms to control for any "diversification discount" (Berger & Ofek, 1995). Seventh, the research uses a measure of diversification with demonstrated construct validity. Eighth, the present study also controls for firm industry (Dess, Ireland & Hitt, 1990) and

environment (e.g., Bluedorn, 1993; Keats & Hitt, 1988) effects. Specific implications, limitations, and opportunities for future research are identified in the following sections.

Implications

Results of the present research have implications for theory, methodology and practitioners. Each is reviewed in turn.

Theoretical Implications

The primary theoretical contribution of the present study is to inform theory development in relation to observed M&A activity and subsequent performance. To date, no theoretical framework has explained adequately the relationship between acquisition antecedents and subsequent performance (Hitt, *et al.*, 1998; Hoskisson, *et al.*, 1994; Sirower, 1997). Current results are consistent with at least two theoretical perspectives—complementary resources and population ecology. Additional theoretical contributions relate to the role of acquired technology, and the concept of absorptive capacity.

*Complementary Resources.*¹³ Complementary resources may explain observed acquisition activity. Complementary resources are difficult to exchange using contracts because each firm party to a contract develops resources where rent generation depends on the goodwill of another firm. Firm-specific resource investments become valueless if the arrangement breaks down (Teece, 1982, 1986). Therefore, firms that are dependent on external, complementary resources use acquisitions to facilitate resource exchange that is otherwise difficult (Anand & Delios, 2002; Williamson, 1975). This in turn reduces firm dependencies (Pfeffer & Salancik, 1978).

¹³ *Complementary resources* are defined as resources that exhibit a relationship where an increase in the quantity of one resource produces an increase in the impact of its counterpart resource [i.e., situations displaying a positive interaction effect between resources (Milgrom & Roberts, 1995)].

The primary theoretical contribution of the current study involves demonstrating that post-acquisition performance is facilitated by an interaction between acquiring and target resources. Specifically, in the case of high-technology targets, firm investments in R&D and marketing display a complementary relationship. Combined with results indicating relative size impacts post-acquisition performance, it appears that the possession of complementary resources by target and acquiring firms positively impacts post-acquisition performance.¹⁴ Several researchers have suggested that post-acquisition performance may depend on target and acquiring firms owning complementary resources (Barney, 1988; Capron, Dussauge & Mitchell, 1998; Capron & Pistre, 2002; Harrison, et al., 2001; Hitt, *et al.*, 1998; Hitt, Harrison & Ireland, 2001; King, Covin & Hegarty, forthcoming; Lubatkin & Lane, 1996). This research provides the first demonstration of the impact of complementary resources on post-acquisition performance using objective measures. Viewing acquisitions as the exchange of complementary resources has implications for how M&A researchers view the relationship between commonly researched variables and performance. For example, the role of premium paid, as in the current study, could have a positive on an acquiring firm's post-acquisition performance rather than a negative impact due to more equal bargaining power. A positive impact of premium paid is opposite the effect portrayed in finance studies of post-acquisition performance that assume target firms have stronger bargaining positions than acquiring firms. Additional implications of viewing post-acquisition performance from the perspective of complementary resources may impact employee retention, the relatedness of a target firm, and firm resource profiles.

¹⁴ The logic behind the complementary nature of firm size is summarized in Table 3.

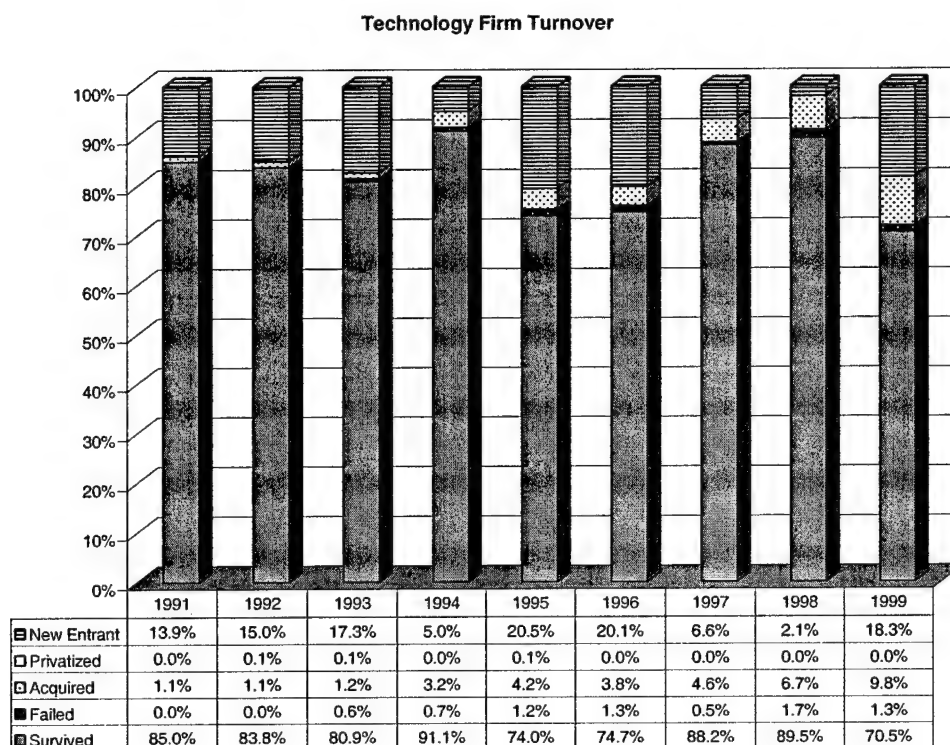
Population Ecology. For an acquiring firm's post-acquisition stock performance the year a firm made an acquisition was significant for 1995 and 1996 ($p < .05$). The regression coefficients for these dummy variables need to be interpreted in relation to the 1994 reference year (see Table 5: Model 5). Since the coefficients for these variables were negative, the implication is that acquisitions completed in 1995 and 1996 performed significantly worse than acquisitions completed in 1994.¹⁵ Population ecology offers one possible explanation for why early acquisitions would outperform later acquisitions (Hannan & Freeman, 1977; Wholey & Brittain, 1986). Early acquirers may "select" the best targets and leave later acquirers with a decreased and less desirable pool of targets from which to select (Anand & Singh, 1997). The reason acquisitions do not improve firm performance on average may be explained by the fact that early acquisitions benefit from early selection advantages and experience higher performance than later acquisitions that under perform. Existing M&A research routinely considers acquisitions from multiple years in a single cross-section, without controlling for year, which may mask any "selection" effect.

Since 1997 is not significantly different from 1994, the results appear to show mixed support for early acquisitions outperforming later acquisitions. However, the nature of the cross-sectional regression employed assumes that the underlying pool of firms does not change. Figure 3 shows that entry rates of firms in technology industries was over 10 percent for the two years before 1994 and 1997. This suggests that the non-significant difference in post-acquisition performance between 1994 and 1997 may result from the ability of acquiring firms to select from a relatively diverse pool of targets in

¹⁵ 1994 represents the beginning of a high-technology merger wave with the percentage of firms acquired doubling in comparison to 1993 (see Figure 3).

both years. Development and empirical testing of a model of acquisition performance based on population ecology that does not treat observations as a single cross-section represents an important research opportunity.

Figure 3: Changes in the Population of Technology Firms



Role of Acquired Technology. In reviewing the different perspectives toward acquiring technology, two conflicting perspectives dominate. Researchers tend to either view external technology as a substitute for (Barkema & Vermeulen, 1998; Bower, 2001; Hitt, Hoskisson, & Ireland, 1990; and Hitt, Hoskisson, Ireland & Harrison, 1991) or a complement to (Christensen, 1995; Cohen & Levinthal, 1989, 1990; Granstrand, Bohlin, Oskarsson & Sjoberg, 1992; Lee, 1995; Lowe & Taylor, 1998; Powell, 1998; Tidd & Trewhella, 1997; and Veugelers, 1997) internal innovation. In the current sample, the average relative R&D intensity for firms acquiring high-technology targets was -2.96 (see Table 4). These R&D intensity levels are significantly less than average industry R&D

spending or zero ($p < .001$), suggesting that firms use acquisitions as a substitute for R&D or that technology can be successfully transferred in acquisitions.

Absorptive Capacity. Cohen and Levinthal (1989, 1990) called the ability of a firm to recognize, assimilate, and convert new information to commercial ends that result from a firm's R&D investments "absorptive capacity." The primary measure of absorptive capacity is a firm's R&D intensity (Cohen & Levinthal, 1990; Mowery, Oxley & Silverman, 1996). However, empirical research examining absorptive capacity has been limited (Mowery, Oxley & Silverman, 1996; Zahra & George, 2002). Research on alliances suggests that absorptive capacity is positively related to firm success (e.g., Lane & Lubatkin, 1998; Mowery, Oxley & Silverman, 1996; Powell, 1998).

While absorptive capacity is a compelling concept, present results demonstrate that the traditional measure of absorptive capacity, an acquiring firm's R&D intensity, is a necessary but insufficient measure of absorptive capacity in the context of high-technology acquisitions. The implication is that the concept of absorptive capacity is too complex to be captured by the traditional measure of R&D intensity alone. Current results suggest that R&D intensity is not enough to "convert" acquired technology into higher performance. Instead, an acquiring firm's R&D intensity may relate most closely to the "recognition" component of absorptive capacity's definition in that more R&D intensive firms may be able to pick better targets. The finding that an acquiring firm's R&D intensity was positively correlated ($p < .01$; see Table 4) to target firm profitability provides some support for this observation.

Methodological Implications

There are at least three methodological considerations that the present research highlights that should be considered by future M&A researchers. These issues involve model specification, performance measurement, and industry type.

Model Specification. The improved R-square achieved in this study indicates that under-specification in prior M&A research is a reasonable concern. Few studies in economics and finance consider the relatedness of acquisition targets (Larsson & Finkelstein, 1999), for example, and most strategy studies ignore the role of premium paid (Sirower, 1997). Future M&A researchers need to build on existing research models by including important variables in their own research to avoid Type I errors resulting from model under-specification (Griffiths, Hill & Judge, 1993: 312) and to facilitate knowledge accumulation. At a minimum, future M&A researchers should consider including the most common M&A research variables summarized in Table 2.

Performance Measurement. The current study uses multiple measures of firm financial performance meeting an identified need to explore differences between accounting and stock market measures (Hoskisson, *et al.*, 1993) allowing an accumulation of research across disciplines (Ramanujam & Varadarajan, 1989). Current results indicate that accounting measures of financial performance result in significantly lower R-square values than stock performance measures. This may account for the apparent disparity in published M&A research, where studies using stock market measures greatly outnumber studies using accounting measures (Bild, 1998). Stock measures are less susceptible to direct manager manipulation (Chakravarthy, 1986) and because they incorporate intangible information may be preferred to profitability measures in M&A research. Future M&A researchers should consider using stock

market measures of post-acquisition performance, and, if information asymmetry or other forms of uncertainty exist, long-term stock market measures should be used.

Industry Type. A final methodological contribution is that in the fully specified models (see Table 5) industry type was not significant. This suggests that the current research findings can generalize across manufacturing and service high-technology industries. Acquisition type appears to be a more important determinant of post-acquisition performance than industry type. This is a potentially significant contribution because the vast majority of existing M&A research only examines mining and manufacturing industries (Empson, 2000; Golbe & White, 1988; see also Appendix A), and in the current sample over 30 percent of acquisition targets were in service industries (see Table 4). Continuing to explore the generalizability of M&A research findings between industry and acquisition type represents an opportunity for future research. Specifically, testing whether results generalize across industry type in other types of acquisitions represents an unanswered question.

Managerial Implications

The present research has clear implications for practitioners. The model presented in this study offers a useful framework that managers can use to predict post-acquisition performance when high-technology targets are acquired because the measures used are objective and either visible to or under the control of managers. The present model could be used as an objective check to their existing M&A evaluation procedures as a means to help them avoid biases involving groupthink or over commitment that may contribute to firms completing acquisitions with a low probability of success. For example, a lack of acquisition experience by top managers in a firm may make them

particularly susceptible to escalation of commitment that can lead to the completion of deals at unreasonably high costs (Haspeslagh and Jemison, 1991).

The results of this study also clearly demonstrate that manager decisions significantly impact post-acquisition performance. For example, the greater information disclosure of tender offers is positively and significantly related to post-acquisition stock performance. This finding coincides with calls for more rigorous due diligence and greater justification for the completion of an acquisition by investors (Eccles, Lanes & Wilson, 1999; Frank, 2002a, 2002b; Marks & Mirvis, 2001). Therefore, greater information disclosure by managers pursuing acquisitions makes sense from both firm performance and stakeholder perspectives. Additionally, the degree of relatedness between an acquiring and target firm has a significant and positive effect on post-acquisition stock performance ($p < .05$). This suggests that managers should think twice before acquiring high-technology targets in areas beyond their firm's primary competencies. Further, managers should avoid pursuing acquisitions unless their firm has sufficient financial resources that provide budgetary slack have been associated with acquisition success (Haspeslagh & Jemison, 1991). In the current study, financial resources are positively associated with increased stock performance ($p < .05$, see Table 5). This observation combined with evidence that acquisitions may predict organizational decline (Hambrick & D'Aveni, 1988) suggests that firms already struggling financially should avoid acquisitions because they will not have the financial resources necessary to achieve a positive outcome.

Interestingly, the role of acquisition experience does not appear to be a significant factor in explaining acquiring firm performance for the acquisition of high-technology

targets. This may suggest that past managerial experience in performing acquisitions has limited generalizability to future acquisitions because each high-technology acquisition brings unique challenges. Alternatively, it may imply that while managers *could* learn from acquisition they do not because they treat acquisitions as unique events (Ashkenas, DeMonaco & Francis, 1997). The high dollar value associated with M&A activity suggests that it could be worthwhile for firms to track lessons learned that could be reviewed during subsequent acquisitions.

A final practitioner implication is that acquisitions can serve as a viable means for managers to obtain needed technology resources. Therefore, managers are cautioned against displaying a "not-invented-here" attitude that would lower any inclination to augment their firm's resources with complementary, externally acquired resources. Instead managers should actively encourage employees to search for external resources that can be combined with a firm's existing resources.

Limitations

Like all research projects, the present study has several limitations that present opportunities for future research. For example, the condition for determining causation of eliminating alternate explanations cannot be completely ruled out in the current study. Specifically, one limitation in the present study exists because the impact of implementation on post-acquisition performance was not examined. Acquisition implementation does impact post-acquisition performance (Haspeslagh & Jemison, 1991; Hoskisson & Hitt, 1990; Larsson & Finkelstein, 1999). However, the present study focused on exploring the impact of acquisition antecedents on post-acquisition performance. Including variables related to integration should only increase the R-square

or the amount of variance explained. Additionally, not specifying variables related to implementation should have a conservative impact since their omission only increases the standard error or decreases the chance of significant findings. Few studies have looked at the implications of acquisition implementation (Ramanujam & Varadarajan, 1989), and the impact of different aspects of target integration represents an opportunity for future research.

Additional limitations involve the generalizability of the study's findings. Although data from a relevant sample of acquired firms was used to test the hypothesized effects, the nature of the sample limits generalizability of the findings. First, the sample was limited to a specific type of acquisition involving high-technology targets. This was in response to a perceived limitation in existing research that generally assumes acquisition activity is homogenous. Future research needs to determine whether the relationships exhibited between acquisition antecedents and post-acquisition performance holds for other types of acquisitions. Second, this research examined only public firms, where data were publicly available. Acquisitions involving private firms were excluded.¹⁶ Third, the sample was limited to U.S. firms, and while acquisition activity is highest in the United States, it is also common in the United Kingdom and Germany (Koretz, 1997). However, this limitation is common in other post-acquisition performance research (see Appendix A). Examining the impact of acquisitions on firm performance outside the United States represents an opportunity for future research. A final limitation of the present study's generalizability is that acquisition activity has been found to vary with the business cycle (Ramanujam & Varadarajan, 1989). The sample in the present study was restricted to a time frame that exhibited favorable economic

¹⁶ M&A research involving private firms is rare because of data availability problems.

conditions. Exploring whether observed relationships are consistent in less favorable economic conditions represents yet another opportunity for future research.

Future Research

This study resulted in two additional insights that offer promising avenues of future research beyond those already identified. One opportunity for additional research involves exploring alternate explanations (beside differences in acquisition type) for conflicting M&A research findings. Conflicting M&A research findings may also result from differences in the motives behind M&A activity. The different motives used to explain M&A activity can be loosely grouped into non-value maximizing and value maximizing categories (Seth, 1990a; Shleifer and Vishny, 1991). Similar to how mixed results may be observed when different types of acquisitions are grouped in the same cross-section, variance in manager motivations may contribute to conflicting M&A research findings that generally assume a value maximization motive. If manager motivations behind M&A activity are not uniform, then research looking at cross-sections of firms will contain acquisitions completed with different motives (Meyer, 1967; Seth, Song & Pettit, 2000, 2002). This could explain the disparity of findings in existing post-acquisition performance research. Trautwein (1990) and Seth, Song and Petit (2000, 2002) recognize the need for research exploring different M&A motives.

Another opportunity exists for researchers to extend the sample to diversified firms. The current research limited the sample to firms that had a 4-digit SIC code identified in *COMPUSTAT*, or firms that operate primarily in a single industry. Firms that acquired high-technology targets but were eliminated from the current study because they were not identified at the 4-digit level could be combined with the current sample to

test whether diversifying acquisitions represent a different acquisition type. For example, research by Berger and Ofek (1995) suggests that diversification represents a suboptimal strategy and destroys value. Testing the current validated model by contrasting whether coefficient values are different for diversified and non-diversified acquiring firms represents an opportunity to determine whether operating as a conglomerate creates value (e.g., Campbell, Goold and Alexander, 1995; Lubatkin, 1987) or not (e.g., Berger & Ofek, 1995; Lang & Stulz, 1994).

Conclusion

This study met recognized needs in M&A research, while minimizing limitations of previous research. This study also provides an improved predictive model of post-acquisition performance. Conflicting findings in existing M&A research appear to result, in part, from identified methodological weaknesses. The current model focused on the acquisition of high-technology targets, included the most common M&A research variables, to avoid model under-specification, and incorporated the interaction of acquirer and target variables. The result was a model that achieved an R-square approximately twice that of prior post-acquisition performance research. The importance of better understanding M&A activity can be seen in reviewing simple statistics. The value of acquisitions completed in the United States was worth over \$1.4 trillion in 1999 (Slywotsky & Wise, 2002), when the U.S. Gross Domestic Product was \$9.3 trillion (National Science Foundation, 2002). In other words, M&A activity represents a largely unexplained phenomenon that corresponds to up to 15 percent of the world's largest economy. This study represents an important step in better explaining M&A activity with results that offer insights for M&A theory, researchers, and practitioners.

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APPENDIX A: Summary of Empirical Research on Post-Acquisition Performance ^a

Author(s)	Performance Measure	Independent Variables	Sample	Analysis	Results
Jensen and Ruback (1983)	Stock market performance	Announcement period, form of acquisition (merger vs. tender offer), and source of gains	Summarizes 13 studies published between 1977 and 1983	Two-tailed significance tests	Corporate takeovers generate positive gains where target firm shareholders benefit and bidding firm shareholders do not lose.
Kusewitt (1985)	Accounting: ROA Stock: 10 year average return	Relative size, acquisition rate, asset acquisition rate, industry commonality, acquisition timing, type of consideration, target profitability, and price paid	128 firms from FTC large merger series making two or more acquisitions between 1967 and 1976	Correlation and multiple regression	Acquisitions increase firm performance. Post-acquisition performance displays an inverted-U relationship with target size and acquisition rate. Related acquisitions and profitable targets are positively related to post-acquisition performance.
Chatterjee (1986)	CAPM: Abnormal stock market returns (-49 to + 50 days)	Type of merger and type of synergy	157 mergers from FTC database between 1969 to 1972	Regression	Acquiring firms exhibit higher stock performance.

^a Listed in chronological and then alphabetical order

Hopkins (1987)	ROA, ROE, and Sales Growth	Acquisition strategy typology	103 active acquirers from Fortune 100 in 1965 that made 2 or more acquisitions worth over \$10M between 1965 and 1979	t-tests	Acquiring firms pursuing strategies demonstrating "strategic fit" were better performers.
Lubatkin (1987)	CAPM: Abnormal stock market returns (-18 to +64 months)	FTC classification: Product concentric, Horizontal and Market concentration, Conglomerate, Vertical	Different samples from 1948-1979 FTC large merger series (A) 257 firms that were infrequent acquirers (B) 439 firms that were frequent acquirers (C) 340 acquired firms	Two-tailed significance tests	Acquisitions lead to permanent gains in stockholder value for both acquiring and acquired firms' stockholders
Ravenscraft and Scherer (1987)	Profitability (Operating income to assets)	Size, type of acquisition (purchase vs. other method), capital intensity, R&D intensity, advertising intensity, imports/exports, industry concentration, minimum efficient scale, industry growth	5,966 mergers from FTC database between 1950 and 1977	Cross- sectional regression	Pooling of interest acquisitions had similar performance as a control group, and purchase accountings experienced sub-control returns.

Singh and Montgomery (1987)	CAPM: Abnormal stock market returns (-800 to +400 days)	Related / unrelated	105 acquisitions valued over \$100M between 1975 and 1980	Regression	Abnormal returns of acquiring firms are not significant in related or unrelated acquisitions.
Fowler and Schmidt (1988)	Accounting: Return on common equity Stock: Return to shareholders	Form of acquisition, plus time and industry specific controls	49 of 118 tender offers between 1975 and 1979 meeting data availability and other conditions matched with 55 acquiring and 44 control firms in same 4-digit industry	t-tests of group means	On average accounting and investor returns decrease significantly after an acquisition when compared to previous performance.
Shelton (1988)	CAPM, abnormal market returns (-1 to +1)	Strategic fit typology, relative size, rival bidders, dummy variable to control for 1969 Williams Act	218 randomly selected mergers between 1962 and 1983	Regression	Acquisitions on average create value, but acquisitions where bidding firms access new but related markets create the most value with the least variance.

Fowler and Schmidt (1989)	Accounting: Return on common equity Stock: Total return to shareholders	Relative size, contested vs. uncontested, acquisition experience, organizational age, percentage acquired, industry commonality	42 manufacturing firms making major tender offer between 1975 and 1979	Bivariate and multivariate	In general, post-acquisition performance was substandard. However, older firms with previous acquisition experience that acquire a majority of a target stand a better chance of success.
Ravenscraft and Scherer (1989)	ROA, ROS, and cash flow to sales	Average share of assets acquired, type of acquisition (pool vs. purchase), merger of equals, internal development, market share, and relatedness typology	2,732 lines of business acquired between 1957 and 1977 as identified by FTC database	Cross-sectional regression	The evidence mandates considerable skepticism toward the claim that mergers on average are efficiency enhancing.
Carper (1990)	Accounting: Earnings growth, dividend yield, PE ratio Stock: Stock price	Acquiring firm vs. non-acquiring firm	6 matched pairs of Fortune 500 firms from 1984.	Matched pair comparison	Acquiring firms did not consistently outperform non-acquiring firms.

Chatterjee and Lubatkin (1990)	Stock market performance	Relatedness	120 mergers from FTC large merger series between 1962 and 1979 classified as concentric or conglomerate with daily stock price data	Two-tailed significance tests	Mergers, on average, may be value creating events that reduce systematic risk to shareholders.
Lahey and Conn (1990)	Stock cumulative mean adjusted return (announcement to 3 years after merger completed)	FTC classification of mergers, single vs. multiple mergers, decade	91 major mergers in FTC database between 1960 and 1979	t-tests	Initially the market reacts differently to merger announcements, but after 3 years the sample as a whole is significantly negative
Schmidt and Fowler (1990)	Accounting: Return on common equity, and executive compensation Stock: Return to shareholders	Firm size, form of acquisition	49 bidding, 55 acquiring, and 44 control manufacturing firms between 1975 and 1979	t-tests and regression	Implementation of a major acquisition did not favorably affect post-acquisition performance.
Seth (1990a)	Stock: CAPM, abnormal market return (-40 to 0) Other: Synergy score	FTC and Porter relatedness typologies	104 tender offers between 1962 and 1979 for manufacturing and mining firms in FTC database with assets over \$10M	z-scores	Value is created in both related and unrelated acquisitions.

Seth (1990b)	Accounting: discounted expected cash flow (-140 to - 41 and 0 to +600) Stock: CAPM, abnormal market returns (-40 to +5 days)	Change in production costs, marketing relatedness, relative size, change in long- term debt, change in total debt	102 tender offers between 1969 and 1979 for manufacturing and mining firms in FTC database with assets over \$10M	t-tests and cross- sectional regression of abnormal returns	There is a significant degree of cash flow measured value creation by all types of acquisition. The different sources of value creation in related and unrelated acquisitions create similar levels of synergy.
Harrison, Hitt, Hoskisson and Ireland (1991)	ROA	Capital intensity, administrative intensity, debt intensity, R&D intensity, and related/unrelated	198 to 441 acquisitions depending on data availability from <i>COMPUSTAT</i> research file between 1970 and 1989	Regression	Differences in resource allocation patterns may provide unique and valuable synergy for acquiring firms.
Hitt, Hoskisson, Ireland and Harrison (1991)	R&D Intensity, Patent Intensity, and Acquisitive growth	Size, ROA, Leverage, Liquidity, Diversifying acquisitions, Total diversification, Average industry R&D intensity	191 acquisitions between 1970 and 1986 across 29 industries	Multiple regression	Acquisitions have a negative effect on R&D investments, and diversifying acquisitions have a negative impact on patents.

Agrawal, Jaffe and Mandelker (1992)	Abnormal Stock market performance adjusted for firm size	Merger vs. tender offer, Conglomerate vs. non-conglomerate, time sub-period	937 mergers and 227 tender offers by NYSE listed firms between 1955 and 1987	Two-tailed significance tests	Stockholders of acquiring firms suffer a statistically significant loss over a five-year post-merger period.
Datta, Pinches and Narayanan (1992)	Stock market performance	Number of bids, bidder's approach, type of financing, type of acquisition, type and source of study data	41 acquisition event studies published between 1975 and 1989	Meta-analysis	Target firm shareholder's gain significantly from acquisitions and those of bidding firms do not.
Healy, Palepu and Ruback (1992)	Abnormal industry-adjusted cash flow returns	Investment characteristics, type of acquisition, method of financing, relatedness, hostile vs. friendly	50 largest acquisitions between January 1979 to June 1984 covering 27 target industries and 33 acquirer industries	Cross-sectional regression	Merged firms have significant improvements in operating cash flows, resulting from increased asset productivity and this improvement is particularly strong for related acquisitions. Sampled firms also maintain their capital expenditure and R&D rates relative to their industry after a merger.

Cannella and Hambrick (1993)	Performance as rated by expert informants	Performance change, executive departure, senior departure, status bestowal, unrelated, horizontal, preacquisition ROE, industry change in ROE	138 of 200 largest acquisitions between 1980 and 1984	Regression	Executives from acquired firms are an intrinsic component of the acquired firm's resource base.
Hoskisson, Hitt, Johnson and Moesel (1993)	Three stock market performance measures Accounting: relative ROA and ROS	Subjective strategy, entropy classification, SIC category, relative ROA and ROS, Sharpe measure, Treynor measure, Jensen's alpha, debt/equity, firm size, and R&D intensity	160 of 200 manufacturing firms with over \$500M in sales randomly selected from those listed on the NYSE and AMEX, in 1988	Structural equation model	Diversification has a negative impact on accounting measures, and an indirect, but negative impact on market performance.
Bruton, Oviatt and White (1994)	Subjective measure by panel of academics	Relatedness, acquisition experience, Relative size, Target performance	51 distressed firms acquired between 1979 and 1987	Multiple regression	Related acquisitions perform better than unrelated acquisitions, and past acquisition experience is associated with acquisition success.

Gerpott (1995)	Self reported: R&D integration success and financial (profit trend, and sales trend)	Acquisition experience, buyer's influence, size of acquirer, size of acquiree relative size, acquiree profitability, market relatedness, technology relatedness, friendliness	92 questionnaires (43% response rate) managers in German firms involved in acquisitions in 1988	Correlation	Relative size is negatively related to acquisition performance.
Brush (1996)	4-digit industry market share	Seven measures of relatedness based on 1977 FTC classification	733 firms in 356 manufacturing industries that changed Trinet parent company codes between 1980 and 1984	Likelihood ratio test and t-tests of logistic regression coefficients	The opportunity to share resources and activities among businesses increases post-acquisition performance.
Hitt, Hoskisson, Johnson and Moesel (1996)	Self reported: External and internal innovation	Acquisition intensity, divestiture intensity, financial controls, strategic controls, product diversification, firm size, average industry R&D intensity, accounting performance (ROA, ROE & ROS), and current ratio	250 of 776 manufacturing firms reporting R&D expenditures for each year between 1985 and 1991	Structural equation model	Firms engaging in acquisition and divestiture activity emphasize financial controls and de-emphasize strategic controls, and thereby produce less internal innovation.

Anand and Singh (1997)	Stock: risk adjusted stock market return (3 day window) Accounting: normalized pre-tax cash flow	Overlapping business, and Tobin's q	Acquisitions of 289 firms in the 10 most defense-dependent industries at 4-digit SIC level between 1978 and 1992	Cross-sectional regression	In declining industries consolidating acquisitions outperform diversifying acquisitions.
Hayward and Hambrick (1997)	CAPM: Abnormal stock market returns (5 days prior to announcement, 5 days after acquisition)	Recent acquirer performance, media praise for CEO, CEO relative compensation, target firm profitability, target poison pill, relatedness, payment method, relative size	106 acquisitions in 1989 and 1992 valued over \$100M and reported in Securities Data Corporation's (SDC) Mergers and Acquisitions database	Hierarchical multiple regression	On average acquiring firm's shareholder wealth declined after acquisitions. The greater a CEO's hubris the larger the shareholder loss. Target firm profitability, relative size, and relatedness not significant.
Krishnan, Miller and Judge (1997)	ROA	Relative size, industry profit, type of acquisition, industry, complementarity, TMT turnover, and prior performance	147 acquisitions between 1986 and 1988	Multiple regression and mediated regression	Complementary backgrounds have a positive impact on post-acquisition performance in both related and unrelated acquisitions.

Lubatkin, Srinivasan and Merchant (1997)	Change in stock market value	Market cycle, Rumelt and product count relatedness measures	132 of 289 mergers between 1980 and 1988 with acquired assets over \$25M and data available	ANOVA	No evidence mergers of 1980s were value creators.
Ramaswamy (1997)	Profitability	Market coverage, marketing intensity, risk propensity, overhead intensity, client mix, pre /post merger performance, relative size	46 intrastate mergers of banks in 1987	Hierarchical regression analysis	Mergers between banks with similar strategic characteristics result in better performance than those involving strategically dissimilar banks.
Sirower (1997)	CAPM: Abnormal stock market returns (28 different event windows)	Premium, contested / uncontested, method of payment, type of acquisition, relative size, related / unrelated	168 firms listed on NYSE and AMEX with target at least 10% relative size of acquirer and valued at least \$100M between 1979 and 1990.	Regression	Acquisitions destroy value in acquiring firms.

Bergh (1998)	Product market uncertainty Portfolio restructuring	Munificence, complexity, diversity, number of employees, debt to equity, institutional ownership, ROA, volatility, divestiture, and acquisition	Panel 168 Fortune 500 companies from 1985 to 1991.	Repeated measures ANOVA	Market uncertainty moderates acquisition performance.
Hitt, Harrison, Ireland and Best (1998)	Industry adjusted ROA and R&D intensity	Complementarities, friendly, debt level, financial slack, change experience, emphasis on innovation, level of diversification, target evaluation, top management team turnover, multiple acquisitions, and opportunism	24 acquiring firms classified as successful or unsuccessful based on ROA and R&D intensity changes from 191 firms completing acquisitions in the 1980's.	Multiple case and rater analysis	Successful acquisitions pursue complementary assets, are friendly, involve low debt, and emphasize innovation. Unsuccessful acquisitions are more diversified, occur at the same time as other acquisitions in a firm, and involve higher top management team turnover.
Rau and Vermaelen (1998)	Bias-adjusted cumulative abnormal stock returns	Form of acquisition, book-to- market ratio	3,169 mergers and 348 tender offers from <i>SDC</i> mergers database of public and private firms between 1980 and 1991	Boot strapping	Bidders in mergers underperform while bidders in tender offers overperform in the three years after an acquisition.

Bresman, Birkinshaw and Nobel (1999)	Self reported: Knowledge transfer, patent count	Communication, visits and meetings, articulability of knowledge, time elapsed, size of acquired unit	42 useable questionnaires (20% response rate) of R&D managers in units acquired by Swedish MNCs between 1927 and 1990	Poisson regression	Communication, and visits and meetings significantly predict knowledge transfer.
Capron (1999)	Self reported: Market share, sales, intrinsic profitability, relative profitability, cost-based synergies, revenue-based synergies	Asset divestiture, resource redeployment, Horizontal scope, Geographic scope, Relative size, and Diversified acquirer	273 completed questionnaires (15% response rate) of executives from manufacturing firms making an acquisition between 1988 and 1992	Structural equation modeling	Cost-based synergies are not easily achieved. Capabilities related to market coverage have the strongest and most immediate impact on acquisition performance. Acquirers are better at redeploying their own resources than a target's resources.

Haleblian and Finkelstein (1999)	Stock: CAPM, abnormal market returns (-240 to +5 days) Accounting: ROA	Acquisition experience, target-to-target similarity, acquirer-to-target relatedness, relative size, stock consideration, acquirer slack, attitude, acquiring firm performance, period effects, and CEO acquisition experience	449 large acquisitions completed between 1980 and 1992	Multiple regression	The more similar a firm's acquisition targets are to its prior targets the better the acquisitions perform. Although initial acquisitions tend to perform better than subsequent acquisitions.
Larsson and Finkelstein (1999)	Synergy Realization	Combination potential, organizational integration, employee resistance, relative size, management style similarity, cross-border, case data collection, case perspective, case publication, case calendar year, and case period length	112 empirical case studies	Case survey and structural equation modeling	Synergy realization depends on the combined explanations of strategic, organizational, and HRM factors
Jones, Lantot and Teegen (2000)	Self reported: Product, finance, and market measures	Dominant design stage, external product technology acquisition, external process technology acquisition, internal resources, and intellectual property protection	188 questionnaires (20% response rate) of managers in U.S. subsidiaries of both U.S. and foreign firms	Multiple regression	Firm performance is negatively impacted by external technology acquisition.

Palich, Cardinal and Miller (2000)	Accounting: Growth and profitability Stock: risk adjusted and unadjusted market returns	Degree of diversification	55 diversification studies published between 1971 and 1998	Meta-analysis	Diversification appears to be positive for firms up to a point, and then past a certain level performance declines.
Seth, Song, and Pettit (2000)	Target and acquirer cumulative abnormal returns	Number of bidders, acquirer gain, and target gain	100 U.S. firms acquired by a foreign corporation between 1980-1990	Chi-square, z score, and regression	Positive total gains (target and acquirer combined) are significantly greater than break even (74% of acquisitions experience total gains).
Ahuja and Katila (2001)	U.S. Patent counts	Number of non-technological acquisitions, absolute size of acquired knowledge base, relative size of acquired knowledge base, relatedness of acquired knowledge base, number of technological acquisitions where patents unavailable, R&D expenditures, Firm Size, Diversification, and Foreign acquisitions	72 firms from global chemicals industry between 1980 and 1991	Poisson regression	Absolute size of the acquired knowledge base reduces innovative output, and relatedness has a nonlinear impact.

Lubatkin, Schulze, Mainkar and Cotterill (2001)	Change in merged product's price	Initial market concentration, change in market share, change in cost, market density, market growth, relatedness, relative market share	2 acquisitions from 1984 in the food manufacturing industry	Regression	Products in a horizontal merger can attain and sustain an increase in performance.
Vermeulen and Barkema (2001)	Acquisition vs. Greenfield	Previous experience, related business, familiar markets or country, diversity, firm size, ROE, cultural distance, GNP, jointly owned venture, time	25 large nonfinancial companies on Amsterdam Stock Exchange in 1993	Logistic regression	Acquisitions can increase firm performance.
Capron and Pistre (2002)	Cumulative abnormal return	Target innovation resources, target marketing resources, target managerial resources, acquirer innovation resources, acquirer marketing resources, acquirer managerial resources, relative size, cross-border acquisition, industry demand, industry capacity, direct competition, economies of scale, reduced capacity, reduced financial risk, turnaround of failing firm, block rival	Survey of 101 horizontal acquisitions completed between 1988-1992	Regression	Target firm resources to not contribute to abnormal returns, but abnormal returns do occur when an acquiring firm transfers its resources to the target.

Finkelstein and Halebian (2002)	Accounting: ROA Stock: abnormal returns	Acquisition relatedness, second acquisitions, relative size, method of payment, acquirer slack, friendliness, acquiring firm performance	192 acquisitions completed between 1970 to 1990	Regression	Related acquisitions are positively related to acquisition performance and second acquisitions under perform initial acquisitions.
Hayward (2002)	Stock market abnormal returns	Acquisition experience, similarity of prior acquisitions, timing of prior acquisitions, industry and temporal variables, firm size, acquiring firm performance, business relatedness	535 acquisitions in six industries between 1985 and 1995	Regression	Acquisition experience is a necessary but not sufficient condition for acquirer learning.
Wright, Kroll and Elenkov (2002)	Stock market abnormal returns	Activist institutional ownership, # of analysts following, independent board members, changes in compensation, changes in sales, CEO ownership, CEO tenure, SIC compensation	182 firms that completed acquisitions between 1993 and 1998	Regression	External monitors may limit selfish managerial behavior, and moderate the relationship between CEO compensation and acquisition activity.

APPENDIX B: Sampled Firms

n	Acquirer	Target
1	EFFECTIVE MGMT SYSTEMS INC	INTERCIM CORP
2	ABBOTT LABORATORIES	MEDISENSE INC
3	ADAC LABORATORIES	COMMUNITY HEALTH COMPUTING
4	ADOBE SYSTEMS INC	ALDUS CORP
5	ADOBE SYSTEMS INC	FRAME TECHNOLOGY CORP/CA
6	AUTODESK INC	SOFTDESK INC
7	AMERICAN HOME PRODUCTS CORP	GENETICS INSTITUTE INC
8	APPLIED MATERIALS INC	OPAL INC
9	ADVANCED MICRO DEVICES INC	NEXGEN INC
10	AMGEN INC	SYNERGEN INC
11	AMP INC	M/A-COM INC
12	ANTEC CORP	KEPTEL INC
13	VMARK SOFTWARE CP	EASEL CORP
14	AMERICAN STANDARD CO INC	INCSTAR CORP
15	COMPUTER PRODUCTS INC	ZYTEC CORP
16	AVID TECHNOLOGY	DIGIDESIGN INC
17	ARCSYS CORP	INTEGRATED SILICON SYS INC
18	MANAGED HEALTH BENEFITS CORP	AVITAR INC
19	BOEING CO	MCDONNELL DOUGLAS CORP
20	BAXTER INTERNATIONAL INC	INTRAMED LABS INC
21	WELLFLEET COMMUNICATIONS	SYNOPTICS COMMUNICATIONS
22	BARD (C.R.) INC	MEDCHEM PRODUCTS INC
23	BIOMET INC	KIRSCHNER MEDICAL CORP
24	BORLAND INTERNATIONAL	OPEN ENVIRONMENT CORP
25	BOSTON SCIENTIFIC CORP	CARDIOVASCULAR IMAGING SYS
26	BOSTON SCIENTIFIC CORP	SCIMED LIFE SYSTEMS INC
27	BOSTON SCIENTIFIC CORP	EP TECHNOLOGIES INC
28	BOSTON SCIENTIFIC CORP	HEART TECHNOLOGY INC
29	BOSTON SCIENTIFIC CORP	TARGET THERAPEUTICS INC
30	BANCTEC INC	TERMINAL DATA CORP
31	BANCTEC INC	RECOGNITION INTL INC
32	COMPUTER ASSOCIATES INTL INC	ASK GROUP INC
33	COMPUTER ASSOCIATES INTL INC	LEGENT CORP
34	COMPUTER ASSOCIATES INTL INC	CHEYENNE SOFTWARE INC
35	CARDINAL HEALTH INC	PYXIS CORP
36	CAMBREX CORP	BIOWHITTAKER INC
37	CUC INTERNATIONAL INC/Cendant	DAVIDSON & ASSOCIATES INC
38	CUC INTERNATIONAL INC/Cendant	SIERRA ON-LINE INC
39	CADENCE DESIGN SYS INC	COOPER & CHYAN TECH INC
40	CHIRON CORP	VIAGENE INC
41	CONMED CORP	BIRTCHE MEDICAL SYSTEMS
42	CANTEL INDUSTRIES	MEDIVATORS INC
43	3COM CORP	CHIPCOM CORP
44	COMPAQ COMPUTER CORP	NETWORTH INC
45	COMPAQ COMPUTER CORP	MICROCOM INC
46	COMPAQ COMPUTER CORP	TANDEM COMPUTERS INC
47	CABLETRON SYSTEMS	NETWORK EXPRESS INC

n	Acquirer	Target
48	CISCO SYSTEMS INC	STRATACOM INC
49	CISCO SYSTEMS INC	TELEBIT CORP
50	CISCO SYSTEMS INC	TGV SOFTWARE INC
51	CHART INDUSTRIES INC	CRYENCO SCIENCES INC
52	DANAHER CORP	ACME-CLEVELAND CORP
53	DRESSER INDUSTRIES INC	WHEATLEY TXT CORP
54	RADIUS INC	SUPERMAC TECHNOLOGY INC
55	ELSAG BAILEY PROCS AUTOMTN	FISCHER & PORTER CO
56	ELECTROMAGNETIC SCIENCES INC	LXE INC
57	ELAN CORP	ATHENA NEUROSCIENCES INC
58	ELSEVIER	MDL INFORMATION SYS INC
59	ELECTRONIC ARTS INC	MAXIS INC
60	EATON CORP	FUSION SYSTEMS CORP
61	FEDDERS CORP	NYCOR INC
62	GUIDANT CORP	ENDOVASCULAR TECH INC
63	GLAXO WELLCOME	WELLCOME
64	GATEWAY 2000 INC	ADVANCED LOGIC RESEARCH INC
65	HALLIBURTON CO	LANDMARK GRAPHICS CORP
66	HBO & CO	SERVING SOFTWARE INC
67	HOLOGIC INC	FLUOROSCAN IMAGING SYS INC
68	INTEGRA LIFESCIENCES HLDGS	TELIOS PHARMACEUTICALS INC
69	SPI PHARMACEUTICALS	VIRATEK INC
70	IDX SYSTEMS CORP	PHAMIS INC
71	INTELIDATA TECHNOLOGIES CORP	COLONIAL DATA TECHNOLOGIES
72	IVAX CORP	ZENITH LABORATORIES
73	JOHNSON & JOHNSON	MITEK SURGICAL PRODUCTS INC
74	JOHNSON & JOHNSON	CORDIS CORP
75	JOHNSON & JOHNSON	BIOPSYS MEDICAL INC
76	JOHNSON & JOHNSON	INNOTECH INC
77	KLA INSTRUMENTS CORP	TENCOR INSTRUMENTS
78	LIGAND PHARMACEUTICAL	GLYCOMED INC
		SPHINX PHARMACEUTICALS
79	LILLY (ELI) & CO	CORP
80	LAM RESEARCH CORP	ONTRAK SYSTEMS INC
81	LUCENT TECHNOLOGIES INC	OCTEL COMMUNICATIONS CORP
82	TOKOS MEDICAL CORP/DE	HEALTHDYNE INC
83	MEDTRONIC INC	ELECTROMEDICS INC
84	MENTOR GRAPHICS CORP	MICROTEC RESEARCH INC
85	MILLIPORE CORP	TYLAN GENERAL INC
86	MALLINCKRODT INC	SYNTRO CORP
87	MALLINCKRODT INC	NELLCOR PURITAN BENNETT INC
88	MACNEAL SCHWENDLER	PDA ENGINEERING
89	MICRON ELECTRONICS INC	NETFRAME SYSTEM INC
90	ANSALDO SIGNAL NV	UNION SWITCH & SIGNAL INC
91	MCAFEE ASSOC	SABER SOFTWARE CORP
92	NETWORKS ASSOCIATES INC	NETWORK GENERAL CORP
93	NORTHERN TELECOM LTD	MICOM COMMUNICATIONS CORP
94	NEXAGEN INC	VESTAR INC
95	NYCOMED AMERSHAM	NYCOMED ASA
96	OCTEL COMMUNICATIONS CORP	VMX INC

n	Acquirer	Target
97	ORACLE CORP	DATALOGIX INTERNATIONAL INC
98	PLATINUM TECHNOLOGY INTL INC	TRINZIC CORP
99	PALL CORP	GELMAN SCIENCES INC
100	RATIONAL SOFTWARE CORP	PURE ATRIA CORP
101	RATIONAL SOFTWARE CORP	SQA INC
102	READ-RITE CP	SUNWARD TECHNOLOGIES
103	ROBOTIC VISION SYSTEMS INC	ACUITY IMAGING INC
104	ROBOTIC VISION SYSTEMS INC	COMPUTER IDENTICS CORP
105	RAYTHEON CO	XYPLEX INC
106	RAYTHEON CO	E-SYSTEMS INC
107	SANMINA CORP	ELEXSYS INTERNATIONAL INC
108	SEAGATE TECHNOLOGY	CONNER PERIPHERALS
109	SILICON GRAPHICS INC	WAVEFRONT TECHNOLOGIES INC
110	SILICON GRAPHICS INC	CRAY RESEARCH
111	SIEMENS	PYRAMID TECHNOLOGY
112	SYNOPSYS INC	EPIC DESIGN TECHNOLOGY INC
113	SYNOPSYS INC	VIEWLOGIC SYSTEMS INC
114	SOLA INTL INC	NEOLENS INC
115	SPECTRANETICS CORP	ADVANCED INTERVENTIONAL SYS
116	STERLING SOFTWARE INC	KNOWLEDGEWARE INC
117	STERIS CORP	AMSCO INTERNATIONAL INC
118	ST JUDE MEDICAL INC	DAIG CORP
119	ST JUDE MEDICAL INC	VENTRITEX INC
120	STORAGE TECHNOLOGY	NETWORK SYSTEMS CORP
121	SILICON VALLEY GROUP	TINSLEY LABORATORIES INC
122	SYBASE INC	POWERSOFT CORP
123	TERADYNE INC	MEGATEST CORP
124	TEVA PHARMACEUTICALS	BIOCRAFT LABORATORIES INC
125	SOFTKEY INTL INC	SPINNAKER SOFTWARE CORP
126	SOFTKEY INTL INC	LEARNING CO
127	THERMO ELECTRON CORP	BIRD MEDICAL TECHNOLOGIES
128	TECHNITROL INC	PULSE ENGINEERING INC
129	VERITAS SOFTWARE CO	OPENVISION TECHNLS
130	METACREATIONS CORP	FRACTAL DESIGN CORP
131	WATSON PHARMACEUTICALS INC	CIRCA PHARMACEUTICALS INC
132	WATSON PHARMACEUTICALS INC	ROYCE LABORATORIES INC
133	DENTSPLY INTL INC	NEW IMAGE INDUSTRIES

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¹⁷ Received "Best Paper" award (#1 of 65) at 2001 Midwest Academy of Management conference

¹⁸ Chosen as 1 of 4 articles published in 2001 that had the most impact on financial planning by Board of Certified Financial Planners